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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

XX.—FROM THE DIVINE ORACLES TO THE HIGHER CRITICISM.

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II. BEGINNINGS OF SCIENTIFIC INTERPRETATION.

AT the base of the vast structure of the older scriptural interpretation were certain ideas regarding the first five books of the Old Testament. It was taken for granted that they had been dictated by the Almighty to Moses about fifteen hundred years before our era; that some parts of them, indeed, had been written by the corporeal finger of Jehovah; and that all parts gave not merely his thoughts but his exact phraseology. It was also held, virtually by the universal Church, that while every narrative or statement in these books is a precise statement of historical or scientific fact, yet that the entire text contains vast hidden meanings. Such was the rule: the exceptions made by a few interpreters here and there only confirmed it. Even the indifference of St. Jerome to the doctrine of Mosaic authorship did not prevent its ripening into a dogma.

The book of Genesis was universally held to be an account, not only divinely comprehensive but miraculously exact, of the creation and of the beginnings of life on the earth; an account to which all discoveries in every branch of science must, under pains and penalties, be made to conform. In English-speaking lands this has lasted until our own time. The most eminent living English biologist has recently told us how in every path of natural science he has, at some stage in his career, come across a barrier labeled "No thoroughfare. Moses."

A favorite subject of theological eloquence was the perfection

of the Pentateuch, and especially of Genesis, not only as a record of the past, but as a revelation of the future.

The culmination of this view in the Protestant Church was the Pansophia Mosaica of Pfeiffer, a Lutheran general superintendent or bishop in northern Germany, near the beginning of the seventeenth century. He declared that the text of Genesis "must be received strictly"; that "it contains all knowledge, human and divine"; that "twenty-eight articles of the Augsburg Confession are to be found in it"; that "it is an arsenal of arguments against all sects and sorts of atheists, pagans, Jews, Turks, Tartars, Papists, Calvinists, Socinians, and Baptists"; "the source of all sciences and arts, including law, medicine, philosophy, and rhetoric"; "the source and essence of all histories and of all professions, trades, and works"; "an exhibition of all virtues and vices"; "the origin of all consolation."

This utterance resounded through Germany from pulpit to pulpit, growing in strength and volume, until a century later it was echoed back by Huet, the eminent bishop and commentator of France. He cited a hundred authors, sacred and profane, to prove that Moses wrote the Pentateuch; and not only this, but that from the Jewish lawgiver came the heathen theology—that Moses was, in fact, nearly the whole pagan pantheon rolled into one, and really the being worshiped under such names as Bacchus, Adonis, and Apollo.*

About the middle of the twelfth century came, so far as the world now knows, the first gainsayer of this general theory. Then it was that Aben Ezra, the greatest biblical scholar of the middle ages, ventured very discreetly to call attention to certain points in the Pentateuch incompatible with the belief that the whole of it had been written by Moses and handed down in its original form. His opinion was based upon the well-known texts which have turned all really eminent biblical scholars in the nineteenth century from the old view by showing the Mosaic authorship of the five books in their present form to be clearly disproved by the books themselves.

But Aben Ezra had evidently no aspirations for martyrdom; he fathered the idea upon a rabbi of a previous generation, and, having veiled his statement in an enigma, added the caution, "Let him who understands hold his tongue." †

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* For the passage from Huxley regarding Mosaic barriers to modern thought, see his Essays recently published. For Pfeiffer, see Zoeckler, Theologie und Naturwissenschaft, vol. i, pp. 688, 689. For St. Jerome's indifference as to the Mosaic authorship, see the first of the excellent Sketches of Pentateuch Criticism, by the Rev. S. J. Curtiss, in the Bibliotheca Sacra for January, 1884. For Huet, see also Curtiss, ibid.

† For the texts referred to by Aben Ezra as incompatible with the Mosaic authorship of the Pentateuch, see Meyer, Geschichte der Exegese, vol. i, pp. 85–88; and for a pithy short

For about four centuries the learned world followed the prudent rabbi's advice, and then two noted scholars, one of them a Protestant, the other a Catholic, revived his idea. The first of these, Carlstadt, insisted that the authorship of the Pentateuch was unknown and unknowable; the other, Andreas Maes, expressed his opinion in terms which would not now offend the most orthodox, that the Pentateuch had been edited by Ezra, and had received in the process sundry divinely inspired words and phrases to clear the meaning. Both these innovators were dealt with promptly. Carlstadt was, for this and other troublesome ideas, suppressed with the applause of the Protestant Church, and the book of Maes was placed by the older Church on the Index.

The new truth appeared but dimly here and there until the middle of the next century, when Hobbes, in his Leviathan, and La Peyrère, in his Preadamites, took it up and developed it still further. The result came speedily. Hobbes, for this and other sins, was put under the ban, even by the political party which sorely needed him, and was regarded generally as an outcast; while La Peyrère, for this and other heresies, was thrown into prison by the Grand Vicar of Mechlin, and kept there until he fully retracted; his book was refuted by seven theologians within a year after its appearance, and within a generation thirty-six elaborate answers to it had appeared. The Parliament of Paris ordered it to be burned by the hangman.

In 1670 came an utterance vastly more important, by a man far greater than any of these—the Tractatus Theologico-Politicus of Spinoza. Reverently but firmly he went much more deeply into the subject. Suggesting new arguments and recasting the old, he summed up all with judicial fairness, and showed that Moses could not have been the author of the Pentateuch in the form then existing; that there had been glosses and revisions; that the biblical books had grown up as a literature; that, though great truths are to be found in them, and they are to be regarded as a divine revelation, the old claims of inerrancy for them can not be maintained; that in studying them men had been misled by mistaking human conceptions for divine meanings; that, while prophets have been inspired, the prophetic faculty has not been the dowry of the Jewish people alone; that to look for exact knowledge of natural and spiritual phenomena in the sacred books is an utter mistake; and that the narratives of the Old and New Testaments,

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account, Moore's introduction to the Genesis of Genesis, by B. W. Bacon, Hartford, 1893, p. 23; also Curtiss, as above. For a full exhibition of the absolute incompatibility of these texts with the Mosaic authorship, etc., see The Higher Criticism of the Pentateuch, by C. A. Briggs, D. D., New York, 1893, especially chapter iv.

while they surpass those of profane history, differ among themselves not only in literary merit, but in the value of the doctrines they inculcate. As to the authorship of the Pentateuch, he arrived at the conclusion that it was written long after Moses, but that Moses may have written some books from which it was compiled—as, for example, those which are mentioned in the Scriptures, the Book of the Wars of God, the Book of the Covenant, and the like—and that the many repetitions and contradictions in the various books show a lack of careful editing as well as a variety of original sources. Spinoza then went on to throw light into some other books of the Old and New Testaments, and added two general statements which have proved exceedingly serviceable; for they contain the germs of all modern broad churchmanship, and the first of them gave the formula which was destined in our own time to save to the Anglican Church a large number of her noblest sons. This was that "sacred Scripture *contains* the Word of God, and in so far as it contains it is incorruptible"; the second was that "error in speculative doctrine is not impious."

Though published in various editions, the book seemed to produce little effect upon the world at that time, but its result to Spinoza himself was none the less serious. Though one of the most religious of men—his theory of the universe led Novalis to speak of him as "a God-intoxicated man," and Schleiermacher to call him a "saint"—he was, for this work, and for the earlier expression of some of the opinions it contained, abhorred as a heretic both by Jews and Christians: from the synagogue he was cut off by a public curse, and in the Church he was regarded as in some sort a forerunner of Antichrist. For all this, he showed no resentment, but devoted himself quietly to his studies, and to the simple manual labor by which he supported himself, declined all proffered honors—among them a professorship at Heidelberg—found pleasure only in the society of a few friends as gentle and affectionate as himself, and died contentedly without seeing any widespread effect of his doctrine, other than the prevailing abhorrence of himself. Down to a very recent period hatred for him has continued. When, about 1880, it was proposed to erect a monument to him at Amsterdam, discourses were given in churches and synagogues prophesying the wrath of Heaven upon the city for such a profanation; and, when the monument was finished, the police were obliged to exert themselves to prevent injury to the statue and to the eminent scholars who unveiled it.

But the ideas of Spinoza at last secured recognition. They had sunk deeply into the hearts and minds of various leaders of thought, and, most important of all, into the heart and mind of Lessing; he brought them to bear in his treatise on the Educa-

tion of the World, as well as in his drama, Nathan the Wise, and both these works have spoken with power to every generation since.

In France, also, came the same healthful evolution of thought. For generations scholars here and there had known that multitudes of errors had crept into the sacred text. Robert Stephens had found over two thousand variations in the oldest manuscripts of the Old Testament, and in 1633 Jean Morin, a priest of the Oratory, pointed out clearly many of the most glaring of these. Seventeen years later, in spite of the most earnest Protestant efforts to suppress his work, Cappellus gave forth his Critica Sacra, demonstrating not only that the vowel pointing of Scripture was not divinely inspired, but that the Hebrew text itself, from which the modern translations were made, is full of errors due to the carelessness, ignorance, and doctrinal zeal of early scribes, and that there had clearly been no miraculous preservation of the "original autographs" of the sacred books.

While orthodox France was under the uneasiness and alarm thus caused, appeared a Critical History of the Old Testament by Richard Simon, a priest of the Oratory. He was a thoroughly religious man, and an acute scholar, whose whole purpose was to develop truths which he believed healthful to the Church and to mankind. But he denied that Moses was the author of the Pentateuch, and exhibited the internal evidence, now so well known, that the books were composed much later by various persons, and edited later still. He also showed that other parts of the Old Testament had been compiled from older sources, and attacked the time-honored theory that Hebrew was the primitive language of mankind. The whole character of his book was such that in these days it would pass, on the whole, as conservative and orthodox; it had been approved by the censor in 1678, and printed, when the table of contents and a page of the preface were shown to Bossuet. The great bishop and theologian was instantly aroused; he pronounced the work "a mass of impieties and a bulwark of irreligion"; his biographer tells us that, although it was Holy Thursday, the bishop, in spite of the solemnity of the day, hastened at once to the Chancellor Le Tellier, secured an order to stop the publication of the book, and to burn the whole edition of it. Fortunately, a few copies were rescued, and a few years later the work found a new publisher in Holland; yet not until there had been attached to it, evidently by some Protestant divine of authority, an essay warning the reader against its dangerous doctrines. Two years later a translation was published in England.

This first work of Simon was followed by others, in which he sought, in the interest of scriptural truth, to throw a new and purer light upon our sacred literature; but Bossuet proved im-

placable. Although unable to suppress all of Simon's works, he was able to drive him from the Oratory, and to bring him into disrepute among the very men who ought to have been proud of him as Frenchmen and thankful to him as Christians.

But other scholars of eminence were now working in this field, and, chief among them, Le Clerc. Virtually driven out of Geneva, he took refuge at Amsterdam, and there published a series of works upon the Hebrew language, the interpretation of Scripture, and the like. In these he combated the prevalent idea that Hebrew was the primitive tongue, expressed the opinion that in the plural form of the word used in Genesis for God, "Elohim," there is a trace of Chaldean polytheism, and, in his discussion on the serpent who tempted Eve, curiously anticipated modern geological and zoölogical ideas by quietly confessing his inability to see how depriving the serpent of feet and compelling him to go on his belly could be punishment—since all this was natural to the animal. He also ventured semi-scientific explanations of the confusion of tongues at Babel, the destruction of Sodom, the conversion of Lot's wife into a pillar of salt, and the dividing of the Red Sea. As to the Pentateuch in general, he completely rejected the idea that it was written by Moses. But his most permanent gift to the thinking world was his answer to those who insisted upon the reference by Christ and his apostles to Moses as the author of the Pentateuch. This answer became a formula which has proved effective from his day to ours: "Our Lord and his apostles did not come into this world to teach criticism to the Jews, and hence spoke according to the common opinion."

Against all these scholars came a theological storm, but it raged most pitilessly against Le Clerc. Such renowned theologians as Carpzov in Germany, Witsius in Holland, and Huet in France berated him unmercifully and overwhelmed him with assertions which still fill us with wonder. That of Huet, attributing the origin of pagan as well as Christian theology to Moses, we have already seen; but Carpzov showed that Protestantism could not be outdone by Catholicism when he declared in the face of all modern knowledge that not only the matter, but the exact form and words of the Bible, had been divinely transmitted to the modern world free from all error.

At this Le Clerc stood aghast, and finally stammered out a sort of half recantation.*

For Carlstadt, and Luther's dealings with him on various accounts, see Meyer, Geschichte der Exegese, vol. ii, pp. 373 and 397. As to the value of Maes's work in general, see Meyer, ii, 125; and, as to the sort of work in question, ibid., iii, 245, note. For Carlstadt, see also Farrar, History of Interpretation, and Moore's introduction as above. For Hobbes's view that the Pentateuch was written long after Moses' day, see the Leviathan, iii, 33.

During the eighteenth century constant additions were made to the enormous structure of orthodox scriptural interpretation, some of them gaining the applause of the Christian world then, though nearly all are utterly discredited now. But in 1753 appeared two contributions of permanent influence, though differing vastly in value. In the comparative estimate of these two works the world has seen a remarkable reversal of public opinion.

The first of these was Bishop Lowth's Prelections upon the Sacred Poetry of the Hebrews. In this was well brought out that characteristic of Hebrew poetry to which it owes so much of its peculiar charm—its parallelism.

The second of these books was Astruc's Conjectures on the Original Memoirs which Moses used in composing the Book of Genesis. In this was for the first time clearly revealed the fact that, amid various fragments of old writings, at least two main narratives enter into the composition of Genesis; that in the first of these is used as an appellation of the Almighty the word "Elohim," and in the second the word "Yahveh" (Jehovah); that each narrative has grammatical and literary characteristics of its own which distinguish it from the other; that, by separating these, two clear and distinct narratives may be obtained, each consistent with itself, and that thus, and thus alone, can be explained the repetitions, discrepancies, and contradictions in Genesis which so long baffled the ingenuity of commentators, especially the two accounts of the creation, so utterly inconsistent with each other.

Interesting as was Lowth's book, this work by Astruc was, as

For La Peyrère's view, see especially his Præ-Adamitæ, lib. iv, chap. ii, also lib. ii, *passim*; also, Lecky, Rationalism in Europe, vol. i, p. 294; also interesting points in Bayle's Dictionary. For Spinoza's view, see the Tractatus Theologico-Politicus, ch. ii and iii, and for the persecution see the various biographies. Details regarding the demonstration against the unveiling of his statue were given to the present writer at the time by Berthold Auerbach, who took part in the ceremony. For Morinus and Cappellus, see Farrar as above, p. 387 and note. For Richard Simon, see his Histoire Critique de l'Ancien Testament, liv. i, chap. ii, iii, iv, v, and xiii. For his denial of the prevailing theory regarding Hebrew, see liv. i, chap. xiv. For Morinus (Morin) and his work, see the Biog. Univ. and Nouvelle Biog. Générale; also Curtiss. For Bossuet's opposition to Simon, see the Histoire de Bossuet in the Œuvres de Bossuet, Paris, 1846, tome xii, pp. 330, 331; also x, 738; also sundry attacks in various volumes. It is interesting to note that among the chief instigators of the persecution were the Port-Royalists, upon whose persecution afterward by the Jesuits so much sympathy has been lavished by the Protestant world. For Le Clerc, see especially his Pentateuchus, Prolegom., dissertat. i; also, Com. in Genes., vi–viii. For a translation of selected passages on the points noted, see Twelve Dissertations out of Monsieur Le Clerc's Genesis, done out of Latin by Mr. Brown, London, 1696; also, Le Clerc's Sentiments de Quelques Theologiens de Hollande, *passim*; also, his work on Inspiration, English translation, Boston, 1820, pp. 47–50, also 57–67. For Witsius and Carpzov, see Curtiss, as above. For some subordinate points in the earlier growth of the opinion at present dominant, see Briggs, The Higher Criticism of the Hexateuch, New York, 1893, chap. iv.

the thinking world now acknowledges, infinitely more important; it was, indeed, the most valuable single contribution ever made to biblical study. But such was not the judgment of the world *then*. While Lowth's book was covered with honor and its author promoted from the bishopric of St. David's to that of London, and even offered the primacy, Astruc and his book were covered with reproach. Though, as an orthodox Catholic, he had mainly desired to reassert the authorship of Moses against the argument of Spinoza, he received no thanks on that account. Theologians of all creeds sneered at him as a doctor of medicine who had blundered beyond his province; his fellow-Catholics in France bitterly denounced him as a heretic, and in Germany the great Protestant theologian, Michaelis, who had edited and exalted Lowth's work, poured contempt over Astruc as an ignoramus.

The case of Astruc is one of the many which show the wonderful power of the older theological reasoning to close the strongest minds against the clearest truths. The fact which he discovered is now as definitely established as any in the whole range of literature or science. It has become as clear as the day, and yet for two thousand years the minds of professional commentators, Jewish and Christian, were powerless to detect it. Not until this eminent physician applied to the subject a mind trained in making scientific distinctions was it given to the world.

It was, of course, not possible even for so eminent a scholar as Michaelis to pooh-pooh down a discovery so pregnant; and, curiously enough, it was one of Michaelis's own scholars, Eichhorn, who did the main work in bringing the new truth to bear upon the world. He, with others, developed out of it the theory that Genesis, and indeed the Pentateuch, is made up entirely of fragments of old writings, mainly disjointed. But they did far more than this. They impressed upon the thinking part of Christendom the fact that the Bible is not a book, but a literature; that the style is not supernatural and unique, but simply the Oriental style of the lands and times in which the books were written; and that they must be studied in the light of the modes of thought and statement and the literary habits generally of Oriental peoples. From Eichhorn's time the process which, by historical, philological, and textual research, brings out the truth regarding this literature has been known as "the higher criticism."

He was a deeply religious man, and the mainspring of his efforts was the desire to bring back to the Church the educated classes who had been repelled by the stiff Lutheran orthodoxy; but this only increased hostility to him. Opposition met him in Germany at every turn, and in England Lloyd, Regius Professor of Hebrew at Cambridge, who sought patronage for a translation

of Eichhorn's work, was met generally with contempt and frequently with insult.

Throughout Catholic Germany it was even worse. In 1774 Isenbiehl, a priest at Mayence who had distinguished himself as a Greek and Hebrew scholar, happened to question the usual interpretation of the passage in Isaiah which refers to the virgin-born Immanuel, and showed then what every competent critic knows now—that it had reference to events looked for in older Jewish history. The censorship and faculty of theology attacked him at once and brought him before the elector. Luckily, this potentate was one of the old, easy-going prince-bishops, and contented himself with telling the priest that, though his contention was perhaps true, he "must avoid everything likely to make trouble, and remain in the old paths."

But at the elector's death, soon afterward, the theologians renewed the attack, threw Isenbiehl out of his professorship and degraded him. One insult deserves mention for its ingenuity. It was declared that he, the successful and brilliant professor, showed by the obnoxious interpretation that he had not yet rightly learned the Scriptures; he was, therefore, sent back to the benches of the theological school, and made to take his seat among the ingenuous youth who were receiving the rudiments of theology.

At this he made a new statement so carefully guarded that it disarmed many of his enemies, and his high scholarship soon won for him a new professorship of Greek; the condition being attached to it that he should cease writing upon Scripture. But a crafty bookseller having republished his former book, and having protected himself by keeping the place and date of publication secret, a new storm fell upon the author; he was again removed from his professorship and thrown into prison; his book was forbidden, and all copies of it in that part of Germany were confiscated.

In 1778, having escaped from prison, he sought refuge with another of the minor rulers, who, in blissful unconsciousness, were doing their worst, while awaiting the French Revolution, but was at once delivered up to the Mayence authorities and again thrown into prison.

The Pope, Pius VI, now intervened with a brief on Isenbiehl's book, declaring it "horrible, false, perverse, destructive, tainted with heresy," and excommunicating all who should read it. At this, Isenbiehl, declaring that he had written it in the hope of doing a service to the Church, recanted, and vegetated in obscurity until his death in 1818.

But despite theological faculties, prince-bishops, and even popes, the new current of thought increased in strength and vol-

ume, and into it at the end of the eighteenth century came important contributions from two sources widely separated and most dissimilar.

The first of these, which gave a stimulus not yet exhausted, was the work of Herder. By a remarkable intuition he had anticipated some of those ideas of an evolutionary process in Nature and in literature which first gained full recognition nearly three quarters of a century after him; but his greatest service in the field of biblical study was his work, at once profound and brilliant, The Spirit of Hebrew Poetry. In this field he eclipsed Bishop Lowth. Among other things of importance he showed that the Psalms were by different authors, and of different periods —the bloom of a great poetic literature. Until his time no one had so clearly done justice to their sublimity and beauty; but most striking of all was his discussion of "Solomon's Song." For over twenty centuries it had been customary to attribute to it mystical meanings. If here and there some man saw the truth, he was careful, like Aben Ezra, to speak with bated breath; or if, like Castellio, under the sway of Calvin at Geneva, he dared speak openly, he must submit to obloquy and persecution. Here, too, we have an example of the efficiency of the older biblical theology in fettering the stronger minds and in stupefying the weaker. Just as the book of Genesis had to wait over two thousand years for a physician to reveal the simplest fact regarding its structure, so the Song of Songs had to wait even longer for a poet to reveal not only its beauty but its character. Commentators had interpreted it at great length; St. Bernard had preached over eighty sermons on its first two chapters; Palestrina had set the most erotic parts of it to sacred music; Jews and Gentiles, Catholics and Protestants, from Origen to Aben Ezra, and from Luther to Bossuet, had uncovered its deep meanings, and had demonstrated it to be anything and everything save that which it really is. Among scores of these strange imaginations it was declared to represent the love of Jehovah for Israel; the love of Christ for the Church; the praises of the Blessed Virgin; the union of the soul with the body; sacred history from the Exodus to the Messiah; Church history from the Crucifixion to the Reformation; and some of the more acute Protestant divines found in it references even to the religious wars in Germany and to the Peace of Passau. In these days it seems hard to imagine how really competent reasoners could thus argue without betraying doubts, after the manner of Cicero's augurs. Herder showed "Solomon's Song" to be what the whole thinking world now knows it to be—simply an Oriental love-poem.

But his frankness brought him into trouble; he was bitterly assailed. Neither his noble character nor his genius availed him. Obliged to flee from one pastorate to another, he at last found a

happy refuge at Weimar in the society of Goethe, Wieland, and Jean Paul, and thence he exercised a powerful influence in liberating human thought.

It would hardly be possible to imagine a man more different from Herder than was the other of the two who most influenced biblical interpretation at the end of the eighteenth century. This was Alexander Geddes, a Roman Catholic priest and a Scotchman. Having at an early period attracted much attention by his scholarship, and having received the very rare distinction, for a Catholic, of a doctorate from the University of Aberdeen, he began publishing in 1792 a new translation of the Old Testament, and followed this in 1800 with a volume of critical remarks. In these he supported mainly three views: first, that the Pentateuch in its present form could not have been written by Moses; secondly, that it was the work of various hands; and, thirdly, that it could not have been written before the time of David. Although there was a fringe of doubtful theories about them, these main conclusions, supported as they were by deep research and cogent reasoning, are now recognized as of great value. But such was not the orthodox opinion then. Though a man of sincere piety, who throughout his entire life remained firm in the faith of his fathers, he and his work were at once condemned; he was suspended by the Catholic authorities as a misbeliever, denounced by Protestants as an infidel, and taunted by both as "a would-be corrector of the Holy Ghost." Of course, by this taunt was meant nothing more than that he dissented from sundry ideas inherited from less enlightened times by the men who just then happened to wield ecclesiastical power. But not all the opposition to him could check the evolution of his thought.

A line of great men followed in these paths opened by Astruc and Eichhorn, and broadened by Herder and Geddes. Of these was De Wette, who, early in the nineteenth century, showed to the world how largely poetical myths and legends had entered into the formation of the Hebrew sacred books, and whose Introduction to the Old Testament gave a new impulse to fruitful thought throughout Christendom. He had, indeed, to pay a penalty for thus aiding the world in its march toward more truth; he was driven out of Germany, obliged to take refuge in a Swiss professorship; and Theodore Parker, who published an English translation of his work, was, for this and similar sins, virtually rejected by what claimed to be the most liberal of all Christian bodies in the United States.

But contributions to the new thought continued from quarters whence least was to be expected. Gesenius, by his Hebrew Grammar, and Ewald, by his historical studies, greatly advanced it.

To them and to all like them during the middle years of the

nineteenth century was sturdily opposed the colossus of orthodoxy, Hengstenberg. In him were combined the haughtiness of a Prussian drill-sergeant, the zeal of a Spanish inquisitor, and the flippant brutality of an ultra-orthodox journalist. Behind him stood the gifted but erratic Frederick William IV, a man admirably fitted for the professorship of æsthetics, but whom an inscrutable fate had made King of Prussia. Both these rulers in the German Israel arrayed all possible opposition against the great scholars laboring in the new paths. But this opposition was vain; the succession of acute and honest scholars continued: Vatke, Bleek, Reuss, Graf, Hupfeld, Delitzsch, Kuenen, and others wrought on in Germany and Holland, steadily developing the new truth.

Especially to be mentioned among these is Hupfeld, who published in 1853 his treatise on The Sources of Genesis. Accepting the "Conjectures" which Astruc had published just a hundred years before, he established what has ever since been recognized by the leading biblical commentators as the main basis of work upon the Pentateuch—the fact that *three* main documents are combined in Genesis, each with its own characteristics. He, too, had to pay a price for letting more light upon the world. A determined attempt was made to punish him. Though deeply religious in his nature and aspirations, he was denounced in 1865 to the Prussian Government as guilty of irreverence; but, to the credit of his noble and true colleagues who trod in the more orthodox paths, men like Tholuck and Julius Müller, the theological faculty of the University of Halle protested against this persecuting effort, and it was brought to naught.

The demonstrations of Hupfeld gave new life to biblical scholarship in all lands, but most important among the newer contributions was that made by Reuss and Graf. The former had developed it by a sort of intuition, but in his timidity had withheld it from publication for nearly fifty years, and he only made it known when Graf's courage strengthened his own.

These men penetrated the reason for a fact which had long puzzled commentators and given rise to masses of futile debate; namely, the fact that such great men as Samuel, David, Elijah, and Isaiah, and indeed the whole Jewish people from Joshua to the exile, showed in all their utterances and actions that they were unacquainted with the Levitical system. These scholars solved the problem by demonstrating that the Law and Ceremonial Code, which the theological world up to that time had so generally believed to have been established at a vastly earlier period, were really the product of a later epoch in Jewish history. Thus was the historical evolution of Jewish institutions brought into harmony with the natural development of human thought;

ceremonial institutions carefully devised being shown to have come after the ruder beginnings of religious development instead of before them. Thus fell another main support of the older biblical theology.

To work out this new discovery and to close for a time this great line of Continental scholars came Kuenen. Starting with strong prepossessions in favor of the older thought, and even with violent utterances against some of his opponents, he was borne on by his love of truth until, in his great work, The Religion of Israel, published in 1869, he took his place as, in many respects, the leader in the upward movement. He, too, opened new paths. Recognizing the fact that the religion of Israel was, like other great world religions, a development of higher ideas out of lower, he led men to bring deeper thinking and wider research to the great problem. With ample learning and irresistible logic he also proved that the Old Testament prophecy was never supernaturally predictive, and least of all predictive of events recorded in the New Testament. Justly has one of the most eminent divines of the contemporary Anglican Church indorsed the statement of another eminent scholar that "Kuenen stood upon his watchtower, as it were the conscience of Old-Testament science"; that his work is characterized "not merely by fine scholarship, critical insight, historical sense, and a religious nature, but also by an incorruptible conscientiousness and a majestic devotion to the quest of truth."

Thus was established the science of biblical criticism. Its further development and results, especially in Great Britain and America, will be next considered.*

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* For Lowth, see the Rev. T. K. Cheyne, D. D., Professor of the Interpretation of the Holy Scripture in the University of Oxford, Founders of Old Testament Criticism, London, 1893, pp. 3, 4. For Astruc's very high character as a medical authority, see the Dictionnaire des Sciences Médicales, Paris, 1820. It is significant that at first he concealed his authorship of the Conjectures. For a brief statement see Cheyne; also, Moore's introduction to Bacon's Genesis of Genesis; but for a statement remarkably full and interesting, and based on knowledge at first hand of Astruc's very rare book, see Curtiss, as above. For Michaelis and Eichhorn, see Meyer, Geschichte der Exegese; also, Cheyne and Moore. For Isenbiehl, see Reusch in Allg. Deutsche Biographie. The texts cited against him were Isaiah, vii, 14, and Matt. i, 22, 23. For Herder, see various historians of literature and writers on exegesis. For his influence, as well as that of Lessing, see Beard's Hibbert Lectures, chap. x. For a brief comparison of Lowth's work with that of Herder, see Farrar, History of Interpretation, p. 377. For examples of interpretations of The Song of Songs, see Farrar, as above, p. 33. For Castellio (Chatillon), his anticipation of Herder's view of Solomon's Song, and his persecution by Calvin and Beza, which drove him to starvation and death, see Lecky, Rationalism, etc., vol. ii, pp. 46–48; also, Bayle's Dictionary, article Castalio; also, Montaigne's Essais, liv. i, chapit. xxxiv; and especially the new life of him by Buisson. For a remarkably frank acceptance of the consequences flowing from Herder's view of it, see Sanday, Inspiration, pp. 211–405. For Geddes, see Cheyne, as

THE BOWELS OF THE EARTH.

By ALFRED C. LANE.

WHITHER man can not go his imagination the more fondly travels. Thus a most striking difference between man and the apes lies in the vast and boundless range of man's curiosity. Curiosity indeed becomes the mother of Science, while the collection of curiosities grows into the scientific museum. It is natural, therefore, that for generations the mysterious and inaccessible north pole and the bowels of the earth have been favorite dwellings for men's fancies. Since the abodes of the dead are equally mysterious and inaccessible to the living, we are not surprised to find these regions combined, and the dead consigned either to infernal—that is, inferior—regions, or, as did the Scandinavian saga, to the frozen north. But it was reserved for the fertile genius of an American naval officer to combine with one fell swoop the solution of all these mysteries into one, by supposing that the world was hollow, and that there was no north pole, but, instead, a vast annular cavity leading into interior and Arcadian regions, auroral glimpses and flashes of whose electric lights sometimes stream beyond the portals. Unfortunately, his solution is erroneous, and it is our aim in this paper to see what light science really has from the dark regions of Proserpine, and to consider why the world can neither be hollow nor stuffed with sawdust. Our light is, of course, indirect, as the depth below the surface of the earth to which man has burrowed is very small. The deepest mines are little over four thousand feet deep; and although, when one sees the rapid strides that the science of mining is making and the unexampled speed with which in the past four or five years shafts have been sunk over four thousand feet deep to tap the rich deposits of native copper on the south shore of Lake Superior, one may soon hope to see mines over a mile deep, yet, if we say that mines will never go down over two miles below the

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above. For De Wette and contemporaries, see Meyer, Cheyne, and others, as above. For Theodore Parker, see his various biographies, *passim*. For Reuss, Graf, and Kuenen, see Cheyne, as above; and for the citations referred to, see the Rev. Dr. Driver, Regius Professor of Hebrew at Oxford, in The Academy, October 27, 1894; also, a note to Wellhausen's article Pentateuch, in the Encyclopædia Britannica. For the view of leading Christian critics on the book of Chronicles, see especially Driver, Introduction to the Literature of the Old Testament, pp. 495 *et seq.*; also Wellhausen, as above; also, Hooykaas, Oort, and Kuenen, Bible for Learners. For many of the foregoing see also the writings of Prof. W. Robertson Smith; also, Beard's Hibbert Lectures, chap. x. For Hupfeld and his discovery, see Cheyne, Founders, etc., as above, chap. vii; also, Moore's Introduction. For a justly indignant judgment of Hengstenberg and his school, see Canon Farrar's History of Interpretation, p. 417, note.

surface, we shall probably not live long enough to see our prediction proved false. The deepest mines, therefore, far from reaching the bowels of the earth, can not pierce so far in proportion as does the mosquito into the human epidermis. And yet we are not wholly without information concerning the deeper regions of the earth.

In the first place, man has succeeded in the weighing of the earth as a whole. In accordance with the law of gravity, if two balls of lead attached to elastic steel rods are placed close to each other, they must attract each other with a force increasing with their masses, but decreasing with the distance which separates them. The steel rods will be very slightly bent toward each other in consequence. But the same steel rods extended horizontally will be far more strongly bent downward, owing to the attraction of this great ball which we call the earth. If, then, we compare the size, the distance apart, and the density of the two balls, and the effect they produce, with the size of the earth, the distance of its center, and the effect it produces, we may find the average density and weight of the earth. We find that the earth weighs much more than would a ball of granite of like size, but less than a ball of iron. Its density is about halfway between the two, and it is about twice as heavy as, on the average, are the rocks at the surface.

Not only do we know the average weight and density of the earth, but we can form some idea as to how that density varies. It must, of course, increase toward the center, as the surface rocks are lighter than the average; but we can be even more precise than that. If we compare two tops of like mass which have similar conditions of support and are spinning away so as to make an equal number of turns a minute, that one will wabble least whose mass is farthest from the axis about which it turns. Therefore a top is often made in the shape of a light upright axis upon which it may turn, and this axis is connected by light spokes to a wheel in the rim of which, as far as possible from the axis, the mass is mainly collected, for we thus have the extra stability. If we have two such tops of exactly the same shape and size and weight, but the one having a wooden wheel spinning on an iron axis, the other having the iron in the rim of the wheel and the axis all wood, the latter will wabble least. Now, the earth is spinning like a top, and the axis about which she spins connects the north and south poles, and points at present nearly to the north star. But this axis wabbles also, and has not always pointed to the place to which it now points in the starry firmament. The time has been (since Egyptian monuments were built) when the pole star was other than the present one to which the lip of the Dipper points, and quite possibly our remote descendants may

look to yet another star as the pole. The wabbling of the earth's axis in the heavens thus indicated is due to the attraction of the sun and the moon on the mass of the earth, and we can obtain, from its observed amount and from the forces known to be producing it, some idea as to how the mass of the earth must be distributed. Still, we can not, even with this help, be absolutely sure as to the law of the density, but we may rule out the idea of a hollow earth, and accept, as agreeing well with all the facts, the suggestion of Laplace that the condensing effect of pressure decreases as the density produced becomes greater. This increase of density with pressure is, of course, in part to be accounted for by the pressure of the outer layers of the earth on those beneath, which increases until it is something enormous, and, of course, tends to squeeze together the interior and thus render it more dense.

There are, nevertheless, limits to this squeezing effect; and there is another thing that we know about the earth's interior—namely, that it is hot. Hence, as the effect of heat is to expand, the increase of heat would tend to counteract the condensing effect of the increase of pressure. That the earth is really hotter within, and that thus the literally infernal regions are actually hot whatever may be said of the metaphorical inferno, is shown by various lines of reasoning.

In the first place, the astronomers tell us (although they are not quite so sure now that the earth may not be a lump of coagulated meteorites) that this world has cooled from a fluid mass. If so, of course it must be hotter inside. Further, although we have pierced but so little a way into the earth, yet everywhere we meet an increasing temperature. The rate of increase varies very much, however. In the deep copper mines of Lake Superior, for example, at a depth of three thousand feet the temperature has risen from a surface temperature of 40° F. only up to about 70° F., which is still quite a comfortable working temperature. This gives an increase of only one degree Fahrenheit per hundred feet. Beneath the peninsula of Lower Michigan there are brines and sheets of mineral water lying in basin form, and very rich in salt, bromides, etc., and of great medical and commercial value. They have been reached by numerous wells which run down to about three thousand feet near the center of the basin, as at Alma and Bay City. The water comes up from the bottom of these wells hot (over 90°), showing a decidedly more rapid increase in temperature than in the copper mines. But the famous Comstock lode, where fabulous wealth lured the miners on, showed perhaps the most rapid increase in temperature that man has ever dared to face. It was, however, doubtless due to the action of hot waters rising from still greater depths—probably the same waters

that deposited the silver ores, still at work. In the mines of this region the miners, naked as savages, reeking with perspiration, drinking pailful after pailful of ice water (twenty tons of ice, or, in another case, ninety-five pounds per man, were used each day), could labor but ten minutes at the drift (in imminent danger of being scalded by striking a stream of hot water) before being overcome by the heat and reeling to a cooler place. Fainting, delirium, even death have been the effect of the reaction on coming to the surface. Verily the Cuban proverb, that a Yankee would be found to go after a sack of coffee though it were at the gates of hell, was not far from the literal truth.

However the rate of increase of temperature may vary, all indications thus agree that less than ten miles below us a red heat is attained and within twenty a white heat. Think of it! Ten miles below us it is red hot. Ten miles above we have the pitiless cold, far below zero, of interplanetary space. To what a narrow zone of delicately balanced temperature is life confined!

From the deeper zones of higher temperatures we have samples furnished us by the volcanoes, opened along great cracks in the earth, whence red or white hot foaming lava rises. They confirm our idea of the downward increasing heat of the earth. These outpourings of molten matter from volcanoes give us some idea also of the composition of the earth. To the path of investigation thus opened we shall return in a moment. They have also given rise to the very prevalent notion that the earth's surface is but a solid crust over a fluid interior of the consistence of lava. Observers on the Hawaiian Islands have even thought they could hear the dashing of the lava waves beneath. But it is not hard to see that the phenomena of volcanoes are far more complex than the mere welling up of a fluid interior. The lava is often more heavy than the crust, and it often stands at different heights in neighboring vents. Moreover, contemporaneous, not far distant vents sometimes furnish quite different material. This could hardly be possible if all volcanoes had a common source. The really essential and important part of a volcanic eruption is the escape of gases, which are or soon become largely steam. This forms the clouds which overhang a volcano, and descends in time of violent eruptions in torrential rains, such as buried Pompeii in mud. Hence, some have supposed that a volcanic eruption was due to the explosive action of sea water reaching the heated interior. But it is perhaps more probable that the gases which escape are originally contained in the lava and burst forth from the interior of the earth on their own account wherever a crack gives them a chance. According to this notion, the working of volcanoes is not unlike that of a bottle of ginger ale. All that is

needed is the formation of some sort of a crack, to answer to drawing the cork, and fizz, away she goes!

Possibly the thought that we live on top of such effervescent stuff may not be comfortable, for it suggests that the whole earth will some time explode if the volcanoes allowing the gas to escape cease to act as safety valves. There are, indeed, astronomical traces of such catastrophes. Stars have suddenly burst into unwonted radiance, only to fade again almost as quickly; and the belt of asteroids around the sun, occupying as they do a place which naturally would be filled by one large planet, have been supposed to represent some disaster in the process of planet-making. Whether the course of life on this world is ended by the world suddenly exploding, or by a slow refrigeration, or whether the world finally drops into the sun, or is knocked staggering through space by some collision, makes little difference to us, however, so long as the inevitable end that none can foresee must some time come.

Something like this giving off of gas from within the earth is a curious "spitting," as it is called, of molten silver, which when melted absorbs much oxygen gas and gives it off again in cooling. Now, the spectroscope has shown us the kinship in composition of matter throughout the universe, so that stars millions of miles away are composed of the very same elements which make up our own earth and our own bodies. Thus, if we grant the possibility of the earth's exploding, we may expect to find fragments of similar explosions, in composition like that of the earth, scattered through space. And, in fact, every once in a while as we gaze into the starry heavens we see a flash and exclaim, "A shooting star!" It is in reality a bit of matter that has come into collision with our atmosphere at such a tremendous velocity that when so struck even the air resists almost like granite. Indeed, sometimes the shock of collisions dissolves these shooting stars into vapor or dust, but at other times they explode, and the fragments reach the earth, and are picked up. Such fragments are commonly known as meteorites, and we examine them with extreme interest to see if they can throw any light on the average composition of the earth. I think we find that they do, for they are closely allied in composition to some of the series of rocks in the earth's crust that have arisen from beneath and are associated with volcanic activity—the igneous rocks as they are called. In general the meteorites are much heavier than the average surface rocks, and their average weight is much nearer that of the whole earth. The heaviest meteorites are composed mainly of iron—native iron—not quite pure, but associated with some nickel and sulphur and also diamond. This last-named interesting component of meteorites was for years overlooked, but Foote's dis-

covery of some sizable lumps of black diamond in the Cañon Diablo meteorite led Mr. Huntington to investigate further in the very extensive collection belonging to Harvard University, and he found, on dissolving sample chips as thoroughly as possible, that a powder remained whose resistance to corrosives and invincible hardness are signs manual of the sovereign of stones. We find, too, in these iron meteorites gases absorbed, such as those at whose door we have laid the responsibility for the production of volcanic eruptions.

Since the weight of our earth and the evidence of sample fragments of planetary matter point to its being mainly iron—if we may not only say that this is an iron age but also an iron world—is it any wonder that iron is so widely distributed, or that it is the universal pigment, even dyeing the blood of our veins? But there is further evidence on these lines at which we have as yet but hinted. We said that meteorites were connected in composition with terrestrial rocks. It is in fact true that native iron similar in structure to that of meteorites is found in some basaltic dikes in Greenland as large masses, and in microscopic quantities elsewhere, and it seems almost certain that it has been torn from the depths of the earth. The rock in which the diamonds occur in the Kimberly mine (and everywhere else where they occur originally, and not in sand and gravel, they are in similar connection) is very rich in iron, is composed of minerals common in meteorites, but is devoid of quartz and feldspar, the commonest minerals of the upper crust. Practically, all the minerals of the meteorites occur native in the earth's crust, but only sparingly, except in connection with rocks that have risen through fissures from beneath. They do not occur in connection with all these rocks, but only in connection with rocks like the Kimberly rock, which are darker and heavier and less siliceous. There are a number of reasons for supposing that these darker and heavier igneous rocks, containing more iron and less silica, have a deeper source than those composed mainly of quartz and feldspar, but we will mention only one. Our earth is wrapped with an atmosphere of oxygen, an element exceedingly ready to enter into combination —so much so that in all our ordinary surface rocks all the other elements are combined with oxygen as much as can be. Now iron, as is well known, has the power of combining with oxygen either in the proportion of three of oxygen to two of iron or in even proportions. The former compounds which have more oxygen are those found in ordinary rust, and are much more readily formed, being the so-called ferric compounds. They are often yellow or red in color. The other compounds containing less oxygen—the so-called ferrous compounds—very readily absorb more oxygen. In fact, their readiness to do so under the

influence of light is at the basis of many photographic processes, notably those of making blue prints and tintypes. Now, of course, in the meteorites containing native iron, not all of the iron is oxidized, and the iron is contained in its less oxidized condition in the other associated minerals, such as the yellowish-green mineral known as chrysolite, sometimes used for a gem. In

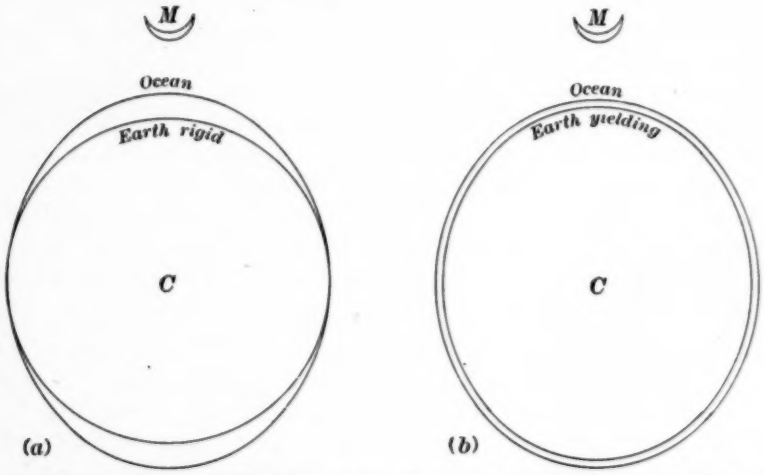

FIG. 1.—MUCH-EXAGGERATED SECTIONS OF THE EARTH THROUGH THE EQUATOR—illustrating (*a*) the tidal effect on a rigid earth with a fluid envelope, (*b*) on a yielding earth.

general, also (there are exceptions), the rocks which contain less silica and more iron have their iron less oxidized. By analogy, as we go from the oxidizing effect of the atmosphere toward the center of the earth, we may expect finally to encounter rocks not oxidized even in the less degree. To sum the argument up in a nutshell, we find among the rocks furnished us by volcanic and igneous agencies from various depths in the earth a series from quartzose and feldspathic rocks to those with less quartz and feldspar, more iron, less oxygen, and greater weight, in which the presence of a trace of nickel and the occasional occurrence of diamonds and native iron betoken a kinship to the meteorites. The latter in every way continue this series toward a goal which is nearly pure iron, and the weight of the earth as a whole is consistent with this idea that it is largely iron, almost purely so at the center, but gradually, perhaps not perfectly uniformly, growing more quartzose toward the crust.

One question still remains to us: In what condition is the interior of the earth? Is it a molten fluid or what? If we look at the downward increase in temperature alone it would seem as if within thirty miles a heat would be reached where even pure iron, which is much less fusible than cast iron containing carbon, would be quite fluid. If the earth were freely fluid, however, it

would yield to the attraction of the sun and moon as the oceans now do. Some effects of this pull may indeed be seen in the distribution of earthquakes, which are more frequent at full moon than at other times, as though the strain produced by the attraction of the moon helped to produce these shocks by the cracking and giving way of the earth. But if the earth as a whole were anything like as fluid as water, it would yield as a whole and assume the same shape, bulging about as much toward the moon as the watery envelope, so that the water would not be perceptibly deeper toward the moon than elsewhere; whereas, if it were perfectly rigid, it would retain its shape unaltered, and the water about it alone would be drawn by the moon. It would be pulled up into tidal waves. These two different cases and effects are illustrated in Fig. 1. As a matter of fact, we find that the heights of the tides are nearly as great as though the earth were absolutely rigid. The earth, therefore, must be exceedingly rigid; we may say solid, so far as these tidal strains are concerned. These are, however,

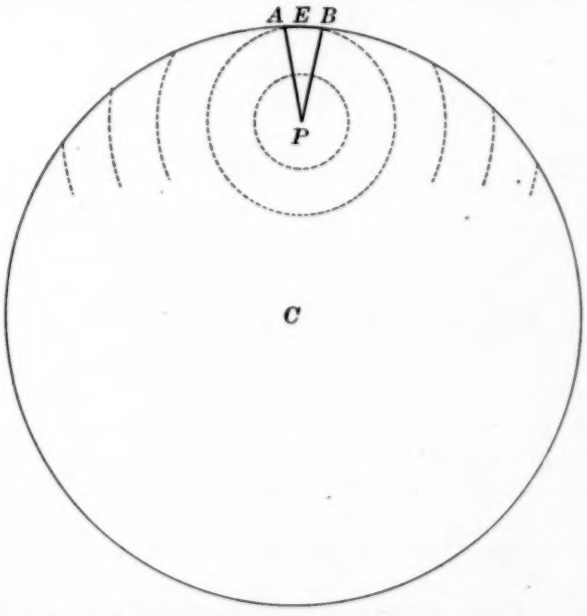

FIG. 2.—P, point of origin of earthquake shock; E (epicentrum), point on the surface directly over it; A, B, limits of the area of vertical, simultaneous, and earliest shock.

so varying in their application, shifting their direction through all the points of the compass every twenty-four hours, that if the interior of the earth is very viscous—and we know that hot iron is in just this viscous condition when at welding heat—the yielding to forces so rapidly changing direction might be no greater than that which is observed.

Another argument for the solidity of the earth is based on the

fact that the mountain ranges and continents are lifted so high above the normal level. To be sure, their weight is not so very great in comparison with that of the earth, nor the distance they project above the general level. But then the breadth of the base in comparison with the height is very great, and if we compute the thrust which so broad an arch as that of the Rocky Mountain plateau, for example, must exert on its abutments, we find that the earth, if not entirely solid, must have a solid crust some hundreds of miles thick; or else possibly that the density of the mountains and the part of the crust beneath them is much lighter than the average, so that they can rise by floating on a liquid interior to their present height. There are, in fact, some indications that these plateaus, and the continents generally, really have lighter matter beneath them than the sea basins do, so that the above argument against the fluidity of the earth has not much weight. Another more important argument for the solidity of the earth may be derived from earthquakes. Sometimes these convulsions of Nature are caused merely by the jar due to a giving way or cracking in the earth's crust. Such cracks we often find in studying the rocks, where on one side of the crack the beds do not match those on the other side, but a particular bed when it comes to the crack line is not found on the other side where we should expect it to come, but some distance to the right or left. Such cracks are technically known as faults, and the displacement produced is sometimes several thousand feet. Such faults or cracks have occurred in the red sandstone area of the Connecticut River, and are well marked. Similar faults have tilted the western plateaus in great blocks. Indeed, even the very line of displacement and sudden elevation have been sometimes noticed after earthquakes, notably in New Zealand and very recently in Japan, after the earthquake described by Koto, that cost so many lives (Fig. 3).

Now, these jars known as earthquakes spread with wavelike motion and decreasing intensity from their source, like the ripples from a pebble thrown into a pond. By careful study of the time at which the jar arrives at different points and of the direction of disturbance we can form some idea of its source, just as one can tell from the ripples at what point the stone was thrown in, even though too late to see the splash. In Japan, a country much afflicted with earthquakes—although, as a friend writes me, the shocks are commonly so slight that the only attention one pays to them is to stop shaving—their study has been so far advanced that one can actually tell what path a particle describes under the influence of a given quake, and what position it occupied at any moment, and a model of such a path was exhibited at the Chicago Exposition.

Let us suppose, for example, that the shock started from the

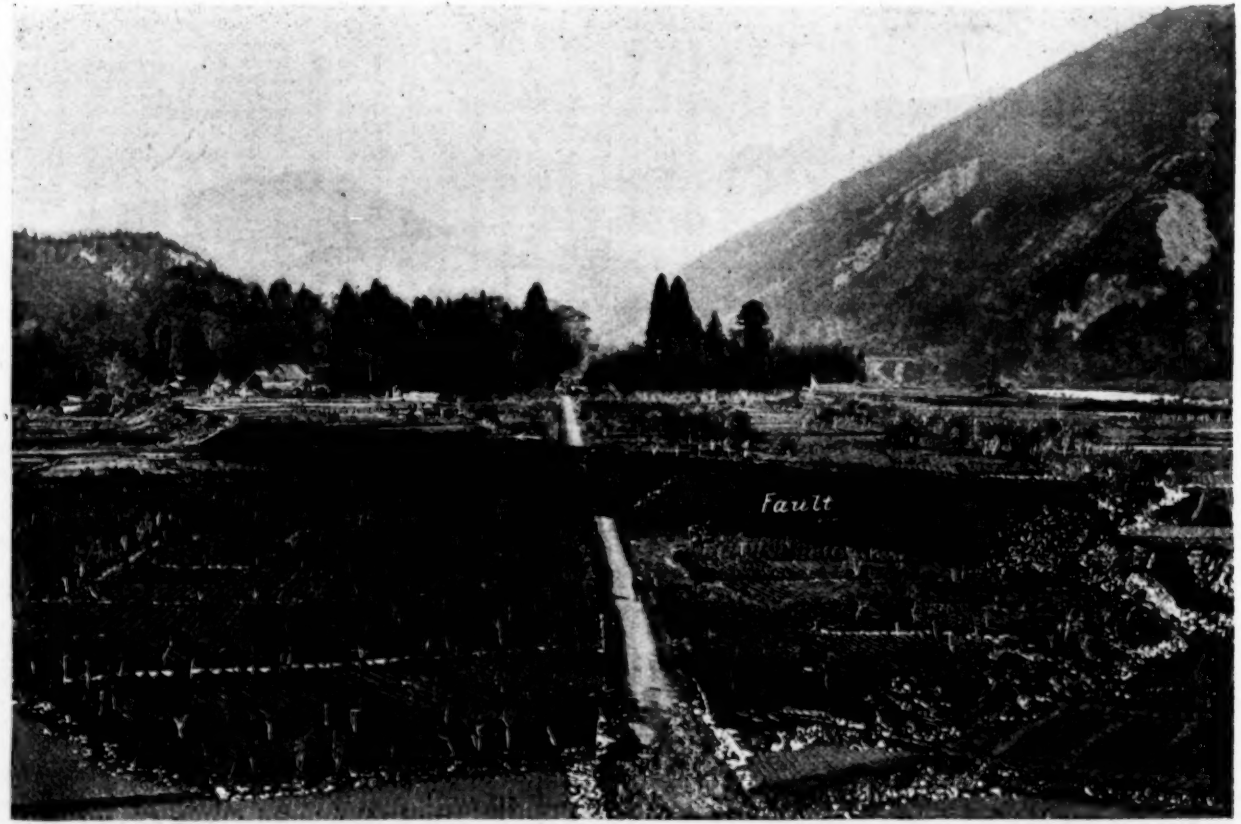

FIG. 3.—VIEW FROM KOTO'S REPORT ON THE CAUSE OF THE GREAT EARTHQUAKE IN CENTRAL JAPAN, IN THE JOURNAL OF THE COLLEGE OF SCIENCE OF THE IMPERIAL UNIVERSITY, Vol. V. The view shows the fault to which that earthquake is attributed. The displacement caused by it is very noticeable on the road.

center of the earth. If we neglect the slight bulging of the earth at the equator, and suppose it a perfect sphere, the shock of the earthquake wave would reach every point of the earth's surface at the same time. It would tend to throw objects vertically upward. Moreover, the intensity of violence would be equal at every point. Now, we can see from the diagram (Fig. 2) that the nearer the surface the source, the smaller will be the area of practically simultaneous first arrival (A, B), the smaller will be the area of vertical shock, and the more rapidly will the intensity decrease from a point of the surface directly over the source (E).

From such considerations the depths of the sources of various earthquakes have been computed. For example, Schmidt computed that the Charleston earthquake started from a depth of no less than one hundred kilometres, say sixty miles. Unfortunately, there has been much difficulty in getting reliable facts enough for these estimates, and Dutton, who investigated the same earthquake for the United States, made it but twelve or eighteen miles deep. But whether it be one depth or the other does not affect what we wish to show—namely, that the earth is capable of cracking to a depth such that if the earth's heat increases at anything like the ratio that it does near the surface, it must there be more than white hot, and would be molten and freely fluid, except for the counteracting effect of pressure. If, then, the earth is solid at this depth, pressure has more effect than heat and keeps the earth solid. Barus has shown by experiment that for the basic rocks pressure tends to solidify. Moreover, the most basic rocks we know, those apparently from the greatest depths, contain fragments of chrysolite, etc., whose rounded and corroded outlines and often blackened edges show plainly that they have been in process of dissolving in the lava. They therefore may represent fragments of deep-seated rocks which have liquefied when pressure has been relieved by cracks and the eruption of lava following thereon.

The fact that we find the rocks in some places crumpled in folds and recrystallized has been by some taken to indicate that such rocks had been buried so deep beneath the surface as to be remelted. But recent investigations, by cutting thin sections of such rocks and studying them under the microscope, have shown that a rock may be thoroughly changed into different minerals, differently interwoven, and may be folded and contorted in most complex fashion, without for a moment being molten or ceasing to be crystalline. Recent experiments have also shown that we may account for the folds and crumplings without supposing a thin, flexible crust lying over a fluid interior; while, on the other hand, there are very numerous faults or cracks, where one part has slidden down on the other, that can hardly be accounted for

except by supposing our earth solid (or very thick in crust), cooling and contracting unequally.

As to other arguments for the fluidity of the earth, we have seen that volcanic phenomena carefully studied go against the idea of one central reservoir for the lavas. It is, of course, natural to think of a cooling globe as having a solid crust and molten interior, but it is quite possible that solidification started at the center, just as even now in the nebulous stars the condensation from gaseous to liquid state proceeds from central points or nuclei.

We may say, then, in summing up, that there are no valid arguments against the conclusion to which all the facts point, that the earth is at heart an intensely hot but practically solid mass of iron.

CLIMATE AND HEALTH.*

By Dr. CHARLES FAYETTE TAYLOR.

IN the divisions of land and water, the situations of the continents, the seas, and the islands in the seas; the mountain ranges and the rivers which have their sources in them; the elevations and depressions of the more even surfaces, together with procession of the seasons and the earth's diurnal revolutions, we have some of the conditions for a great variety of climates. Proceeding from the equator toward the poles or moving along the surface of the earth in any direction, man, who seems to be the toughest animal on the face of the earth, can so adjust himself to varying climatic conditions as to exist in fairly good health almost anywhere, from the steaming equatorial jungles to the regions of perpetual ice and snow, as well as in intermediate locations where often heat and cold vary from one extreme to the other in rapid succession. And yet men live and thrive in nearly all lands and under the most diverse conditions, and with intelligent self-adjustment to their environment they may live well and live out their allotted times as a general rule. While the human race is exceedingly flexible, and can adapt itself rapidly to very diverse conditions, such adaptations, be they rapid or relatively slow, are not accomplished without an expenditure of energy to correspond with the functional modifications thus brought about. We call the process acclimatization, and the person, after subjection to the process, we say is acclimatized. That is to say, the functional activities of such a person have become adjusted to his environment; his functions have learned to harmonize with the

* Read before the New York Academy of Medicine, October 4, 1894.

temperature, food, humidity, and other influences affecting him. The effect on the individual varies according to his susceptibility and the degree and intensity of the factors acting on him. In some cases sluggish functional activities are energized with a tonic effect. But when that is the case it does not follow that the new climate is necessarily intrinsically better than the one from which he came. In other cases the effect of climate change often proves atonic, depressing, and injurious; but a bad effect on an individual does not prove that the climate is necessarily worse than the one to which he was formerly accustomed. It may happen that influences, good in themselves, may be injudiciously employed: as, if a person requiring a cooler climate, such as that of the coast of Maine, for instance, should try Labrador, and it should be more than he could bear; or, if one needed a milder climate and should find Para too depressing. Even the relatively slight difference between the European and American sides of the Atlantic often proves serious to the immigrant during the process of acclimatization, and many succumb, though it is probably true that the majority of immigrants find themselves invigorated in their new conditions of life on this side of the Atlantic.

My object is to call your attention strongly to the well-known fact that change of climate and its attendant circumstances, even when not of any extreme character or degree, does produce an impression more or less profound on the vital processes, and that the nature, degree, and general therapeutic or pathological character of these influences should be more carefully studied than they have thus far been studied, so that when consulted by our patients we may have some definite advice to give in regard to locations best suited to the inquirer's special needs; or, if we can not do so much, we ought at least to be able to give our patients some very positive ideas as to the kind of climate to seek, and especially what to avoid. For instance, California is seven hundred and seventy miles long. It embraces, according to Dr. Remondino, at least seven climates, distinctly different from each other, and all very different from the climatic conditions existing on this side of our continent. What is the sense in telling a patient with a hole at the top of his lung to "go to California" without instructing him in regard to the location to which he should go, or at least what kind of climate he should look for? Without some specific information such a patient is likely to drop into a place better calculated to shorten than to prolong his days. To be sure, all the climates of California are characterized by a dryness exceeding what is known in the east, and this fact gives some relative advantages. But unquestionably the air may be too dry in certain localities for certain cases. Is it not too much to expect a patient to find out what the doctor who sends

him away from home and friends himself does not know? Besides, there are many constituent elements which enter in to make up what we call "climate." The first of these to be mentioned is usually the thermometrical readings, and the "mean" temperature is generally quoted as proof positive of superiority when it varies a few degrees one way or the other from that of another locality with which it is compared. Now, the truth is, that to know the mean temperature of a place, and to know only that, is to know very little about its climate. The physiological effects of a climate must necessarily include the degree of humidity, the force and direction of the prevailing winds, the sunshine and cloudiness; the fogs and their characteristics—whether thin or dense, high or low, whether coming down from the mountains or rolling in from the sea; besides other unmeasurable influences not seen though felt: all these and more must be appreciated in order to give the single factor of relative temperature any positive quality whatever. For instance, the mean temperature of the seven hundred and seventy miles along and near the coast of California varies but a few degrees, though the extremes vary much. But the physiological effects of the climates of different areas vary greatly. There are stiff northwest winds from off the Pacific, carrying a thin, swift-moving fog that chills an invalid to the bone, during July and August in San Francisco. To correspond to the sensations, the thermometer there lies like a cheap watch, and should be twenty degrees lower. A few miles back from the coast, with less wind and little fog, one's bodily comfort is perfect, and life is worth living, though the unlucky thermometer persists in recording nearly the same average as when you had been shivering on the coast. I conclude that the physiological influence of a given temperature below a certain degree, say below sixty, with the wind ten or fifteen miles an hour, is equal to at least ten or fifteen degrees lower in scale. On the other hand, a thermometrical showing of 90° and over is not uncomfortable if there is a gentle breeze and little humidity, but with a strong wind becomes a sirocco, when prostrations are numerous, and, if long continued, many aged and feeble die under its influence. In one of the interior valleys of California I have seen the thermometer indicate 100° to 110° F. for days and weeks together, and no one complained of the heat as excessive, while all labor of man and beast went on as usual, and prostrations are unknown. I refer to the temperature in the shade. In the sun, where men work, it must be ten or fifteen degrees higher. In New York, when summer heat approaches 90° we expect many prostrations and some deaths. I am not trying to show that 110° of heat in California with no prostrations is a better climate than New York at 90° and many prostrations, but to illustrate the

principle that we must know much more about a climate than what the thermometer can tell us before we know very much about it. I kept a record of the temperature in Martinique, one of the Windward Islands lying in 14° north latitude, and it never went above 86° F., nor so high but two or three times during a residence of three seasons, and once so late as the 1st of July. But no sensible person would dare to expose himself to the mid-day sun with the same impunity that he could in this latitude and a corresponding temperature. The ever-present humidity, bordering on saturation, in the tropics is an important modifying element to be taken into account.

Again, temperature may depend on latitude or on altitude; but it is not a matter of small moment which the cause may be. Sixty degrees of heat at the level of the sea and on the seashore are very unlike in physiological effect to 60° in the dry and rarefied air of an elevated inland situation. There is no doubt that considerable moisture in the air favors the growth of minute organisms, and decomposition of matter takes place rapidly under the influence of heat and moisture. On the other hand, a dry air retards decomposition, and, if sufficiently dry, prevents it entirely, no matter how hot it may be. The Sacramento Valley is very hot in the summer, but it is also dry, so that friends of mine would kill a beef and elevate the carcass by means of rope and pulley to the top of a tall pole, let it down from time to time to cut from it, and it would keep perfectly sweet until it was all eaten up. A good illustration of conditions retarding or favoring the growth of minute organisms may be seen during the orange harvest in portions of California. The altitude of Redlands, California, averages about fifteen hundred feet above sea level. Fogs seldom reach there, the sun shines clear more than three hundred days of the year, and there is not a speck of mildew on any fruit. But go forty miles nearer the sea and seven or eight hundred feet down nearer the sea level, and at every station you will see many people washing oranges. More fogs, denser air, less sunshine, more humidity favor fungous growths. On the high table lands of the central portions of the continent, at an altitude of six or eight thousand feet, as in Wyoming, where a friend lives, milk does not "sour" or change under a week or ten days, and the carcasses of dead cattle, of which there are many, give no offensive stench, but slowly dry up and waste away, showing that comparatively few organic germs exist there, and that the conditions for their rapid propagation are unfavorable. From the facts just stated—and they are representative facts—it would be too hasty to conclude that the higher and drier locality is essentially more healthy than the lower and moister locality, even for consumptives, until we have mastered and estimated the

quality and energy of the other meteorological influences. There is another fact which has come under my personal observation which must be taken into consideration. It is that life in those elevated nonmicrobian regions is not without its drawbacks. Whether it is due to the increased action of the heart in the rarefied atmosphere, the constant hammering of the nerves by the winds and the fierce sunshine, or all these and other causes, people in those regions have a thin and tired look, and it is found useful and often necessary, especially in cases of women and children, to visit lower, damper, and more germ-laden regions in order to recuperate. It is important that the air we breathe should contain as few disease germs as possible; but it is still more important that we should breathe an air and live under such climatic conditions as shall most conduce to such general bodily vigor as will resist the entrance of disease germs into the organism, or destroy them if an entrance is once effected. It is quite conceivable that a dry atmosphere containing few microbes may be too dry for an irritable mucous membrane, and set up catarrhs which may furnish nesting places for disease germs; while a moister, softer air, though holding many more microbian elements, may be more advantageous, at least in certain cases. In these latter days, in the wonderful strides which have been made and are constantly being made in bacteriology, perhaps we are in some danger of losing sight of meteorology in its relations to health and disease. It seems to me that climatology has heretofore to a large extent resolved itself into a search for some place where consumptives can not die. There is no such place. There is no place where the ever-present bacillus may not get in its deadly work. The chief question in climatology in its relation to health should be, "In what climate, or by what changes and influences of different climates, can we be best invigorated for good existence in the location where we are obliged to live the greater portion of our lives?" Many other causes besides tuberculosis men die of. Among civilized people, especially among our pushing Americans, debility, nervous exhaustion in one form or another, from overactivity of brain or body, render multitudes asthenic and vulnerable to the invasion of disease. We say that such cases need to be "toned up." This is undoubetdly true, but there are many cases in which the first step in "toning up" should properly be to tone them *down*. By that I mean that it is necessary to diminish the unnecessary expenditure of energy which has become a fixed habit of life. We all, as a rule, are too prodigal of our resources, and squander vast quantities in excess of what the occasion requires. It is amazing to see people, intelligent about ordinary things, traveling for their health at a rate that suggests that they have been shot out of a

gun. Many do, of course, get a limited benefit in the change of subjects of thought, but they often mistake change of feeling due to excitement for recuperation. We need to learn how to stop. Instead of rushing across the face of the earth in the delusive hope of finding health on the other side, we need to learn how to sit down and make ourselves comfortable where we are. A man who had lived to a great age in health and contentment was asked to give some simple rule of life out of his experience. In reply, he said, "The only rule I can give is, 'Always keep comfortable.'" I feel confident that a well-selected residence in the tropics from time to time will prove helpful in acquiring habits of reposefulness. Tropical heat is not oppressive, as many who have not tried it seem to suppose. It is very different from the same temperature as indicated by the thermometer during a northern summer. One does not fret about the tropical heat as he is apt to do here, but is inclined to keep quiet, lie down and sleep a good deal during the daytime as well as profoundly all night. Wakefulness is a rarity. The relief from nervous tension and irritability is inexpressibly delightful. The increased action of the skin relieves and gives needed rest to overworked kidneys, the air passages are bathed by a moist, bland, nonirritating, warm air, no chilly draughts scourge the nerve centers into activities wasteful of energy, morbid appetites are allayed, digestion is improved in sympathy with increased skin activity, and the poor invalid begins to feel that, after all, life may be worth living. It is a delusion, born of constant assertions of the advocates of negro slavery before the war, that white people can not work in the tropics. The island of Porto Rico was originally settled by Catalonian peasants, and the major part of the farm labor has from the beginning till now—say for approaching four hundred years—been done by white men. True, negro slavery was introduced there, but of a milder type than in the other islands; and the blacks never amounted to much more than one third of the population, and they rapidly mixed with their Spanish colaborers beside whom they worked. The facts are still more startling in regard to the Spanish Main. Along the coasts of Central America the mahogany cutters, called "Indians," are mostly of mixed negro blood; and along the unhealthy shores of the Magdalena River, or wherever the sugar cane is cultivated, negro slaves were introduced, and their descendants, largely mixed with the Indian race, still remain. Even in Brazil the negroes and their descendants are confined to a few provinces, and never to exclude white labor; and in numbers the African blood constitutes but a small proportion of the ten or twelve millions in that country—certainly not enough to influence the following statement: From the southern border of the United States through Mexico, the

republics of Central America, Colombia, Venezuela, Ecuador, Peru, Bolivia, Chili, Paraguay, Uruguay, the larger part of Brazil, Argentina, down to Patagonia, with the exceptions above mentioned, there is not now and there never has been any farm labor but white farm labor since the settlement of that vast continent; and the widest portion is directly under the equator. I do not include the Indians in this statement, because when wild they do not work in the sense here meant, and when brought under the influence of the Spanish and Portuguese civilization they immediately mix with and become essentially one with their white coworkers. I do not deny that there are pestilential lagoons which are more pestilential than any similar territory to be found north. But I do not believe that, shunning local conditions which would be bad anywhere, and worse in the tropics, well-selected locations are unhealthy because of tropical heat and moisture, except in certain cases. On the other hand, I believe that almost all elderly people and a large number of overworked and tired-out persons would find that tropical life costs a largely diminished outlay of energy with a corresponding husbanding of nervous and metabolic forces. In illustration of the foregoing statement I give the following facts:

The island of Dominica lies in fifteen degrees north latitude and contained twenty-nine thousand people in 1885. Dr. Nicholls, the chief medical officer of the island, whom I personally know, made a report to the managers of the Colonial Exhibition held in London in the year 1886, in which he stated that the death rate of the preceding year was fifteen and a half per thousand of the population—that is to say, the death rate in this small island, deep in the tropics, was less by ten per thousand than the average for New York city. The people are mostly blacks. Further inquiries revealed the fact that there were, at that time, three hundred and ninety-one white people—men, women, and children—and that there had been two deaths among them during the previous year: one from apoplexy and one, a nun, died from phthisis, which she had brought from England, she having come to the island in the hope of benefit to her health. In fact, there was not one death among the whites from any disease generally supposed to be especially tropical. The death rate is higher in some of the other islands, but not higher, according to the best information I could get, than in northern communities from the same classes of diseases. It should also be remembered that many of the West India Islands are in a deplorably bad sanitary condition, exposing them to be scourged from time to time by importations of yellow fever, smallpox, and such like epidemics, when, of course, the death rate is largely increased. The foregoing applies more especially to the Windward Islands, which possess some conspicuous

advantages over the Greater Antilles, in that they lie in the path of the northeast trade winds, and, being small, the winds sweep over them as over the deck of a ship. There is no alternating sea breeze and land breeze, because there is not sufficient land to be heated by day to form an upward current, and to cool by night and form a downward and outward current; but there is always a gentle movement of the air toward the west, without the intervals of calms which characterize the Greater Antilles. But any of the West India Islands, no doubt, furnish many locations in good sanitary condition where the intelligent invalid may find bodily and mental repose, and let his muscles relax and take comfort, while his enfeebled skin, long constringed by cold and debilitated by clothing, is stimulated by genial warmth to doing its long-neglected duty, for a time at least, while the kidneys, heart, and lungs are given a much-needed rest.

It should be understood that I do not think all cases would be benefited by a sojourn in a tropical climate, but I feel assured that for a large number of carefully selected cases no resource of climate can be so promotive of improved metabolism as a well-selected location and suitably regulated life during several winter months in the tropics, from time to time, especially if closely followed by a change to a higher latitude or altitude and cooler locality during the following summer.

Not least among the advantages of a tropical climate for a temporary sojourn in certain cases is the change of food which is, or at least ought to be, always effected. It would be a very unwise proceeding to subsist upon a diet essentially the same as one is accustomed to at home. In the first place, there are not many of our American stomachs that do not need a rest, and one of the objects to be sought in living in a warm climate is to give the overworked stomach a chance to recuperate; not only because there is no necessity for the same amount and quality of food to be digested, but we can find in the fruits of a country food which is not only very easily digested, but which supplies nearly all the requisites for wholesome nutrition under the changed conditions. The best fruits of the tropics are very perishable—so much so that we never see them in New York. Now, I am not advocating an exclusively fruit diet; but I think when people from the north go to the tropics for "climatic therapeutics" they should make it a point to eat very sparingly of meats and even farinaceous food, and endeavor to supply Nature's wants by using largely of the fruits of the country—especially those soft, sweet, and perishable fruits which do not last more than a day or two. Thus we have, besides the influences of steady warmth and moisture, the added advantage of a change of diet, which is no small factor in modifying the metabolism which we seek.

I have spoken of the Windward Islands as being especially desirable during the three or four months of the so-called "dry season," or from December to May, and of the whole West India Islands as furnishing desirable locations for climatic rejuvenation. The West Indies are especially interesting because communication is so easy and constant and relatively cheap; they are practically at our door, and it seems to me that they should be studied more. The Spanish Main also furnishes a great variety of especially desirable locations which can be used for the same purposes; but in speaking to the question of climate in "therapeutics" my object is not to advocate any particular point, but to illustrate the general subject.

When one has become rested by a some months' sojourn in a tropical region, and, as the season advances, goes north instead of sweltering in New York or other corresponding place, it would be well to go to the seashore or to the mountains, where he would receive another form of tonic to his already partially recuperated energies. In that way we should be using the climate as an essentially "therapeutic means."*

The larger number of invalids and tired-out people will continue to go to Europe for their change, and undoubtedly that is the better course for the majority, and, when properly managed, the "therapy of climate" may be sufficiently realized in that manner in most cases. I do not include those people who travel for pleasure only, or where change of climate is the secondary object, though in many instances even those persons do reap real advantage from the considerable change in food, air, and the surrounding conditions of life. There are many advantages to Americans in visiting Europe, not the least of which is the change of interests which new and different objects for contemplation furnish, and that fill the mind without taxing it to the temporary displacement of the business, political, domestic, or other cares and anxieties which are apt to hold our American mind in a tenacious grip from sheer force of habit. With three thousand miles of ocean behind us, it is not easy to talk "shop" with the neighbor at our elbow during the ten minutes some people devote to their lunch or dinner, and we are almost obliged by prevailing custom to take a reasonable time at meals and be quiet about it. I believe that the climate of Europe is no better than ours, and in some respects not so good. I am told that life-insurance statistics—the most reliable of all—show that the life expectation is somewhat longer among American risks

* For more detailed information in regard to the West Indian climate, I refer those interested in the subject to several articles in The Times and Register, by Dr. William F. Hutchinson, beginning in the number for September 6, 1890.

than in European; and there seems to be no evidence among athletes or race-horses that bodily vigor is not equal here, to say the least, to anything across the water. But there is a difference in meteorological conditions, and this difference may be very effectually used to invigorate and improve the metabolism in a large number of cases if we keep this object steadily in mind and manage toward the accomplishment of this end. There is not only the mental relaxation not possible here in the midst of ordinary pursuits, but the change of climatic conditions, though not so great as a change to tropical lands, is still considerable—quite enough, when properly utilized, in connection with mental and bodily rest, change of food and cooking, change of many habits, and the gentle but quite positive mental tonic of new scenes and new interests. With some important exceptions to be presently noticed, I do not think it makes very much difference where our American tired-out or half invalids go, provided they actually get rest and always keep comfortable. Of course, I do not include those thousands who are always on the rush, "doing" Europe. Among other influences there is no doubt, in my mind, of the great therapeutic value in many cases of well-regulated courses of mineral waters, when the cases and the waters are carefully selected and as carefully directed to the peculiarities of each case. Nothing could be more reprehensible, from the therapeutic point of view, than for an American family to turn itself loose in Carlsbad, for instance, and drink haphazard of these powerful waters —powerful for harm as well as for good—without the advice of a competent physician, experienced in their use and effects, as I have been told our brethren sometimes do. My experience with physicians at some half dozen European spas has been very satisfactory, and leads me to believe that the local doctors are generally capable, honest men, and that their advice ought to be generally sought and followed with confidence in the use of the waters. But we, on this side, ought to be able to give clear advice, if not as to the particular mineral spring, at least as to the general character of the waters to be sought; and especially it is always important to urge our countrymen not to overdo the matter. I am speaking more especially of that vast horde of tired-out health-seekers who annually cross the Atlantic and for whom there can be no better therapy than judicious change of climate, including mineral waters for a certain number as an added and potent alterative. Taking Carlsbad as perhaps the representative spa of the Continent, I am of the opinion that there are few middle-aged or elderly persons who are not decidedly the better for having their capillaries physicked and their emunctories cleaned out once in a while by a course of Carlsbad water sufficient for that purpose; and it is astonishing what

a small quantity of the water will sometimes do it to the extent here contemplated.

There is some danger to the novice in going into semitropical regions in being unacquainted with and unprepared for the degree of apparent cold which he is likely to find to his great surprise. And when he looks at the thermometer he is further surprised to see it so high while his feelings indicate a much lower temperature. He is still more astonished to notice that the natives do not mind the cold that makes the novice shiver. The fact is that without his accustomed fire and housewarming facilities, and subjected to air currents, the practical temperature in its physiological effects is much lower than the thermometer registers. In Spain, Italy, and in general along the Mediterranean shore, they have a semitropical climate during eight or nine months of the year, during which time the native inhabitants hold their calorifacient function in reserve, and when they reach their short and moderately cold season they have no difficulty in drawing sufficiently on their reserve heat-making power. The man from the north has no such reserve, and what he has the temperature is not sufficiently stimulating to call into full activity. He has used up his caloric in the greater cold of the north. People from the extreme south enjoy their first northern winter. I met, in Teneriffe, an intelligent captain of a whaling ship who had several times fished in the Bering Sea. He said it is customary for whalers to make up for loss of men from desertions by taking on South Sea islanders. He said they bear the cold and hardships of the north as well as New Bedford whalemen, and in proof related the following incident: One morning, when far north, he noticed on coming on deck one of his South Sea islanders entirely naked taking a bath. There was a strong wind blowing, and it was so cold that the water he dashed over him froze as it struck the deck. The man seemed to enjoy it, though he had never seen frozen water or snow before. There are good reasons why people of the north with impaired stamina should not expect to bear exposure so well as natives of semitropical regions and should make themselves, in regard to temperature, more comfortable than would be sufficient for the natives.

Northern people should be particularly careful in going to a climate with a temperature too low for comfort without a fire and too high for comfort with a fire. Even the increased sunshine is not sufficiently constant, and all rooms do not face the south. No matter what natives may say, Americans ought always to have the means for heating when occasion requires, and a southern aspect to their rooms everywhere in southern Europe, if they are at all sensitive to cold, irrespective of the thermometer,

or else travel north till they come to fireplaces, stoves, ovens, or other means for artificial warmth. Inquiry into the sanitation not only of residences but of the towns should never be neglected. I suppose the climate of the southern and southeastern coast of Spain is perhaps the most genial on the Mediterranean, and equally the most dangerous for Americans to abide in on account of the lack of proper drainage and other attention to sanitation. But the same may be said of much of the coast except on portions of the Riviera, where in certain places much improvement has been and is being effected in that respect.

There are generally good reasons for many of the customs and habits of the natives of any region, and there will be found advantages in adopting many of their ideas and methods so far as practicable. Along the Riviera people flock indoors with the going down of the sun: and there is good reason for it. At Nice, I have seen the thermometer register a fall of 25° F. within an hour as the sun neared the horizon. Such sudden cooling might be dangerous to an American dyspeptic with his limited power of reaction. Going indoors reduces this difference of temperature. Right across the Gulf of Lyons, in Barcelona, Spain, in nearly the same latitude and about the same mean temperature, the habit of the people is to be out of doors in the evening, promenading, visiting theaters and *cafés*, and the ladies doing their shopping till midnight and after. They find evening the best time for many purposes because there is very little change between the temperatures day and night. My thermometer was hung in an alley which the sun never reached, and all I could make it do was to record the extreme difference of two degrees between six o'clock in the morning and two o'clock in the afternoon during a week. I was still a thermometer dupe at that time. I have since broken my thermometers, and they will never endanger my sanity any more.

But it is not always convenient or even possible for one needing the therapeutic advantages of change of climate to go to Europe, nor is such a change necessary or even desirable in many cases. There is a great deal of as good climate as the world affords in our own country; and almost any change from low to high temperature, from damp to dry, from low to high altitudes, from seashore to mountains, from regions of high cultivation to the balsamic air of primeval forests or the reverse, can be had without the fatigue and expense of long sea voyages and wide stretches of turbulent sea between the traveler and anxious friends at home. The "sunny south" offers much that is admirable both in quality and variety of climate suited to various conditions. The main idea should not be the search for the perfect climate which does nowhere exist, but the question should be, "What

change is indicated for the case in hand?" The question, to be properly answered, necessarily includes a knowledge of the region in which the individual has been living. Shall an inhabitant of Virginia go south or north for the winter? Or, had he better go west, or northwest, or southwest? Shall a New-Yorker go to Florida, and, if to Florida, shall it be into the tonic Atlantic breezes of the eastern shore, or the milder and softer air of the Gulf coast? Does this person's condition and meteorological surroundings indicate a change to the rarefied air of Colorado or to the denser atmosphere of Tennessee, Michigan, or Minnesota? Ought the change to be to the moist breezes and frequent rains of Washington in the northwest or to the constant sunshine and more even temperature of southern California in the semitropical southwest? If the Pacific slope seems indicated, shall it be in the coast cool winds or the warm and calm interior valley? Or, had we not better make a new climate of our own? The bosom of great Ocean furnishes a variety of climates all its own. In former days a sea voyage was much resorted to for chronic invalids, and with decided advantages in many cases. A life at sea, if at all prolonged, has the disadvantage of leaving too many comforts behind to be recommended for any but the young and comparatively robust. It is said that three hundred miles from land the air is free from living germs. Many persons have returned from long voyages in health entirely restored.

But we need not go to sea, or go abroad, or even to the south, or to the wide west. We can make a climate of our own if we properly work for that end. It is not even necessary to rattle over ten miles of pavement in order to get a change of air. We have it right there on the veranda; we can have it fresh from the outside grand air, by opening the windows and opening them wide till all the stale air in the room is blown out and all the room is filled with ozone. We can change our food at home if we like. I know a man who almost rejuvenated himself by living on little else than fish, oysters, and clam juice for three months. We can regulate the temperature and take a sun-bath whenever the sun shines. And we can stop fretting if we are sufficiently determined to do so. Actions are but the evidence of a predetermination. Why not determine to change our climate, when there is benefit to be derived from such change?

It has always been the unsolved puzzle of my professional life that so many people insist on reaching out to a distance for much that can be had better right at hand if they would but open their hand and take it. This is especially so in regard to climate and changes of climate. Notwithstanding positive directions to the contrary, many a child in pain with joint disease has been taken out miles over rough pavements "for the air," while every jolt

was agony, when the same air could be had in his bedroom, with pleasure and safety, by bundling him up and opening the windows and keeping them open. It is against the law to live in cellars, but we make cellars of our rooms by keeping them filled with impure air. I do not inveigh, as it is the fashion to do, against the temperature at which our American houses are kept; a higher temperature is a necessity of our climate; but some one has yet to secure a fortune and the blessings of mankind by devising a system which will keep our houses always filled with living, moving, fresh air, and that will oblige everybody to attend to this matter as he ought.

And here I wish to enter an earnest protest against the practice of sending patients, often far gone with consumption or other wasting disease, away from friends and the comforts of home, without knowledge of what would be best for them, in a fruitless search for health, when, in their enfeebled state, better conditions could be instituted at home where at least they could die in peace. Some, not too far gone, do recover, it is fortunately true, but many lie buried there, and more are sent east in long boxes. On my last trip east, a young girl sat in front of me, whose mother's body accompanied her, and opposite me sat a gentleman and his wife whose daughter's body was also in the baggage car. In neither of these instances had the invalids been more than a short time west. Too many such things are happening for the credit of our profession. Send patients, in time, with a definite intention in the change of climate sought, or do not send them at all.

My object has been to call attention to the many and often difficult questions involved in the therapeutics of climate in its wide and varied significance. Probably no one now lives who is capable of answering all the questions relating to "therapeutics of climate," but they will be answered some day and correctly answered; and when answered it will be found, I believe, as a general thing, that the best climate for consumptives is also the best for other persons in like general physical conditions. Twenty years after our profession more fully realizes the immense value of "climate in therapeutics"—and hundreds of capable men have been studying the subject from that point alone, and valuable material has been created to draw upon—a climato-therapy may be formulated which will give the divine art of healing a new uplifting, not less glorious than that which in our day has attended the labors of Pasteur, Koch, Lister, and others whose immortal services have so enriched the world.

MR. BALFOUR'S DIALECTICS.

By HERBERT SPENCER.

IN early stages of progress gods, conceived as man-like in so many other respects, are conceived as man-like in their credulity: deceptions being consequently practiced upon them. Sometimes in place of a human being an animal dressed up as a human being is immolated. Among the ancient Mexicans effigies of men were subject to sacrificial ceremonies like those to which actual men had been subject. The Chinese carry the system of sham offerings very far; making paper-models of properties, utensils, and money, and burning them to propitiate the worshiped beings. And there are peoples among whom deceptions of this nature are practiced in the avowed belief that their gods are stupid. So that as the marauding Basuto expects by certain sounds to deceive the gods of the people he is robbing, so, in other cases, the semblance of an offering to a god is supposed to be mistaken by him for the reality.

What is the relevance of these facts? Well, I am reminded of them by observing how easily deluded is that many-headed god to whom in our day multitudinous sacrifices are made (especially of convictions), and before whom so much incense is burnt —the god Demos, I was about to say, but remembering the restricted meaning of the word, let me say instead the apotheosized Public, whose fiat, uttered through its delegates, is thought to be a final criterion of good and evil, right and wrong. For this modern deity is deluded with scarcely less ease than the year-god of the Chinese is supposed to be deluded by paper offerings. Similarly lacking in discrimination, it does not distinguish between a semblance and a reality; and when the process of destroying the semblance has been gone through, it shows, by demonstrations of delight, that it thinks the reality has been destroyed. A good illustration was furnished at the last meeting of the British Association by Lord Salisbury. Beginning his presidential address with the remark that he felt like "a colonel of volunteers" reviewing "an army corps at Aldershot," but shortly assuming the manner proper to a colonel of the guards reviewing the "awkward squad," he set forth what he professed to be the hypothesis of Natural Selection; and then, with an amusing simile, thrust it through, and, as it seemed to the onlooking public, let out its life-blood. Whereupon came through the press rounds of applause, and among readers much throwing up of caps and laughter at the fallacy detected: even comic verses, illustrative of the supposed absurdity, being published. Very curious was it to observe how a doctrine which Mr. Darwin had spent a life in

elaborating, and which had been under examination and discussion by the whole biological world for a generation, was thought to be thus readily disposed of by a scholar's mate. Very curious, too, was it to observe the different effects produced in the world of science and in the outer world. Neither in the recent controversy between Dr. Wallace and Professor Henslow, nor in the criticisms of Mr. Bateson's late work, nor in the discussion before the Royal Society on Professor Weldon's experiments and views—all of them concerned with aspects of Natural Selection—is there the slightest sign that Lord Salisbury's attack had produced any impression whatever: a serene disregard showing that its irrelevance was tacitly recognized by all. Meanwhile the extreme improbability that there could be achieved so easy a triumph being overlooked, there was great rejoicing among those who stand by the old; even to the extent that a bishop and a dissenting minister were heard exchanging congratulations on what they supposed to be a defeat of the common enemy!

And now I have to make a remark to which the foregoing illustration is preliminary—the remark that this slaying of effigies entails on those concerned a provoking choice of alternatives. Either the attack must be noticed for the purpose of showing that the thing disproved was not the thing said, in which case time and energy, often much wanted for other purposes, must be spent; or else the attack must be passed by in silence, in which case readers assume that nothing is said because there is nothing to say—that the misstated view is the actual view, and the criticism of it fatal. For it never occurs to them that silence may result from preoccupation or from the belief that controversy is futile, or from ill-health. Once more, after many repetitions, I have myself to choose between the two evils. As the issue raised by Mr. Balfour is important, I reluctantly decide to accept his challenge.

Limitations of time and space oblige me to leave some controverted views of mine undefended; as instance certain ethical and æsthetical ones. I must content myself with saying that those who turn to my own expositions of them will carry away different impressions from those given by Mr. Balfour's burlesques. But before entering on the essential question, something may fitly be said concerning Mr. Balfour's assumptions and his methods. Let us look first at one of his assumptions.

"What remedy remains?" he asks; referring to the inadequacy of reasoning "based upon ordinary experience" to "enable us to break out of the Naturalistic prison-house." "One such remedy consists in simply setting up side by side with the creed of natural science another and supplementary set of beliefs, which

may minister to needs and aspirations which science can not meet." * And then, further on, respecting a certain "patchwork scheme of belief," he says—"If and in so far as it really meets their needs I have nothing to say against it, and can hold out small hope of bettering it. It is much more satisfactory as regards its content than Naturalism." †

Is there not in these passages an indirect begging of the question? The title of Mr. Balfour's work is *The Foundations of Belief*. Belief in what? Not in any of those doctrines which he groups together under the name of Naturalism; but in the opposed doctrine, Supernaturalism—belief in a Ruling Power such as that which the current creed asserts. If the existence of such a Power is tacitly assumed by the arguments urged in proof of it, the reasoning is circular. But unless the existence of such a Power is assumed, how can it be assumed that the constitution of things is one which "ministers" to men's "needs and aspirations," or provides a theory which is "satisfactory"? In the absence of the assumption that things have been by some agency prearranged for men's benefit, there seems no reason to expect the order of the Universe to be one which provides for men's mental "needs and aspirations"; and that the truth of a theory may be judged by the degree in which it conforms to such expectation.

Tests furnished by other creeds clearly show this. If a North American Indian, confidently looking forward to a "happy hunting-ground" after death, is told that there is no such place, is the fact that the creed offered to him negatives his hopes a reason for rejecting it? When the baselessness of his belief in an unlimited supply of *houris* to be hereafter provided, is shown to a Mahommedan, may he urge that his "needs and aspirations" can not be otherwise satisfied, and that therefore his faith must be true? Or once more, if to the half-starved and over-worked Hindoo, to whom it is a consolatory thought that by placing himself under the wheel of Juggernaut's car he may forthwith ascend to heaven, there comes the demonstration that he can not thus gain happiness, is the fact that the alternative belief is not "satisfactory" a sufficient ground for adhering to his superstition? Doubtless the needs and satisfactions which Mr. Balfour has in view are of a higher order than those instanced, but that does not alter the issue. The question is whether the comforting character of a belief is an adequate reason for entertaining it; and the answer to this question is not to be determined by the quality of the comfort looked for, as high or low.

The truth is that Mr. Balfour's view, here tacitly implied, is a more refined form of that primitive view which regards things as

* *The Foundations of Belief*, p. 186. † Ibid., p. 187.

all arranged for human benefit—the Sun to rule the day, the Moon to rule the night, animals and plants provided for food, and the seasons beneficently adjusted to men's welfare. It is the anthropocentric view. But the anthropocentric view does not appear acceptable to one who contemplates things without foregone conclusions. When he learns that millions upon millions of years passed during which the Earth was peopled only by inferior brutes, and that even now three-fifths of its surface are occupied by an ocean-basin carpeted with low creatures which live in darkness, utterly useless to man and only lately known to him; and when he learns that of the remaining two-fifths, vast Arctic and Antarctic regions, and vast desert areas, are practically uninhabitable, while immense portions of the remainder, fever-breeding and swarming with insect pests, are unfit for comfortable existence; he does not recognize much adjustment to the wants of mankind. When he discovers that the human body is the habitat of thirty different species of parasites, which inflict in many cases great tortures; or, still worse, when he thinks of the numerous kinds of microbes, some producing ever-present diseases and consequent mortality, and others producing frightful epidemics, like the plague and the black death, carrying off hundreds of thousands or millions, he sees little ground for assuming that the order of Nature is devised to suit our needs and satisfactions. The truth which the facts force upon him is not that the surrounding world has been arranged to fit the physical nature of man, but that, conversely, the physical nature of man has been molded to fit the surrounding world; and that, by implication, the Theory of Things, justified by the evidence, may not be one which satisfies men's moral needs and yields them emotional satisfactions, but, conversely, is most likely one to which they have to mold their mental wants as well as they can. The opposite assumption, tacitly made by Mr. Balfour, obviously tends to vitiate his general argument.

I have sometimes contended, half in jest, half in earnest, that, having but a given endowment of any mental faculty, its possessor can not use it largely for one purpose without partially disabling it for other purposes; and that, conversely, great economy in one direction of expenditure makes possible an excess in some other direction. It seems to me that, in his manifestations of doubt and faith, Mr. Balfour affords some support to this hypothesis. Of his extreme economy of belief here is an illustration.

After first quoting from me the sentence:—"To ask whether science is substantially true is much like asking whether the sun gives light"; he goes on:—"It is, I admit, very much like it. But then, on Mr. Spencer's principles, *does* the sun give light? After

due consideration we shall have to admit, I think, that it does not." And he then proceeds to argue that the proposition is doubtful, or indeed untrue, because I hold that certain elements of it—matter, space, time and force—are, when fundamentally considered, incomprehensible. Now this, which at first sight appears to be simply a vicarious skepticism, proves, on inquiry, to be a skepticism of Mr. Balfour himself. For since, as shown on p. 284, he holds the same view that I do respecting these "ultimate scientific ideas," what he calls *my* principles are, in this region, *his* principles. So that, making the substitution, the sentence should run:—"But then, on my principles, *does* the sun give light?" The statement that the sun gives light is in his view not a certainty but the contrary.

Turn now to Mr. Balfour's converse attitude. As a result of economies of belief, like the foregoing, he is able to regard as necessary certain assumptions which seem to me to have no warrant. The following passages from p. 302 supply an example:—

> "The ordered system of phenomena asks for a cause; our knowledge of that system is inexplicable unless we assume for it a rational Author. . . .
>
> "We can not, for example, form, I will not say any adequate, but even any tolerable, idea of the mode in which God is related to, and acts on, the world of phenomena. That He created it, that He sustains it, we are driven to believe. How He created it, how He sustains it, it is impossible for us to imagine."

Here, then, is implied the belief, apparently regarded as unquestionable, that while one ultimate difficulty can not be allowed to remain without solution, another may be allowed so to remain. But why, if it must continue "impossible for us to imagine" the mode of operation of the cause behind "the ordered system of phenomena," may it not continue "impossible for us to imagine" the nature of that cause? If we are obliged to assume the cause to be "a rational Author," since otherwise our knowledge of "the ordered system of phenomena is inexplicable," why must we not assume a certain mode of action by which "He created" and "sustains" "the ordered system of phenomena," since otherwise the creation and sustentation of it are inexplicable? To me it seems an indefensible belief that while for one part of the Mystery of Things we must assign an explanation, all other parts may be left without explanation. If the constitution of matter defies all attempts to understand it, if it is impossible to understand in what way feeling is connected with nervous change, if wherever we analyze our knowledge to the bottom we come down to unanalyzable components which elude the grasp of thought, what ground is there for the belief that of one part of the mystery, and that the deepest part, we must and can reach an explanation? Surely there is a strange incongruity in holding that we

have here a certainty while denying to be certain that the sun gives light.

A considerable portion of *The Foundations of Belief* is occupied by a discussion of the relative claims of Reason and Authority. Certainly, in whatever other ways Mr. Balfour's argument tends to discredit Reason, it does not here discredit it by example; for in general and in detail it is in this case characterized by philosophic grasp, clear discrimination, and unusual lucidity of statement. But while agreeing with him in his estimate of the relative shares of Authority and Reason in determining our beliefs, and while holding as he does that life would be impossible if all our beliefs had to be formed by Reason without the aid of Authority, I would emphasize the fact of which he is himself conscious, that it is impossible to go completely behind Reason; for if any other ruler is raised to the throne, in part or for a time, it is by Reason that this is done. Reason can not be essentially discredited by Reason: the attempt ends in suicide. In one case only—that, namely, in which the question is between the verdicts of Reason and those of simple Perception, chiefly of objective existence—may Reason, estimating its own powers, voluntarily abdicate; since critical examination of its processes shows that it can not take even a first step toward discrediting the intuitions which yield the consciousness of external existence without tacitly positing these intuitions as data, and connoting the coexistence of subject and object by all the words it uses;* and that, consequently, all it can do in this sphere is to explain incongruities so as to harmonize these intuitions with one another and with itself. But while this limitation holds where the opposition is between mediate and immediate knowledge, it does not hold where the opposition is between two kinds of mediate knowledge —the verdicts of Reason and those of Authority. Hence, in estimating the relative claims of Reason and Authority we have to bear in mind that the supremacy of Reason is exercised in the act of choosing the Authority. How, exercising this supremacy, does it make the choice? Clearly by comparing the degrees of trustworthiness of authorities as ascertained in experience. That we do this when the authorities are individual men is undeniable. We ask how often their respective statements have been verified, and how often the guidance they have severally yielded has proved good. If, looking back, we see that the statements made by the one have habitually corresponded with facts, and that the advice given by him has been shown by the result to be wise, while many statements of the other have been disproved at the

* *Principles of Psychology*, §§ 388–412.

same time that his suggestions have been misleading or impracticable, Reason obliges us to accept the first authority rather than the second. And if we have to select one of two conflicting masses of authority of the kind Mr. Balfour so well describes as largely influencing our beliefs apart from Reason, we must determine their respective claims to our confidence in a similar way. What are the authorities between which we have to choose? Briefly characterized, Mr. Balfour's book is a plea for Supernaturalism *versus* Naturalism, and unless his section insisting on the "beneficent part" which Authority plays in the production of beliefs is without any *raison d'être*, it is clear that the aggregate of influences composing the authority which supports Religion is set against the aggregate of influences by which Rationalism, considered by him as a form of authority, is supported. The authorities which uphold Theology and Science respectively are the two in question. Let us, then, observe what happens when we test their relative values as we test the relative values of individual authorities.

From the days when Chaldean priests began to record eclipses, and after a time partially discovered the cycle they follow, and were so enabled to foresee their recurrence with approximate truth, down to our own day, astronomical knowledge has been growing ever more exact and more extensive, until now the celestial motions are so perfectly known, that a transit of Venus or an occultation of Jupiter by the moon, fulfills expectation to the minute. So is it throughout: the previsions of the chemist having reached such a stage that, foreseeing the possibility of an unknown compound which must have certain properties, he proceeds to form it, and creates a substance which has never before existed, answering to his anticipations. If from this ever-increasing verification of scientific statements and inferences we turn to the guidance Science has afforded, allied evidence everywhere surrounds us. Led by Science mankind have progressed from boomerangs to 100-ton guns, from dug-out canoes to Atlantic liners, from picture-writing on skins to morning journals printed twenty thousand per hour; and that over all the developed arts of life Science now presides scarcely needs saying.

With the Authority of Science, thus daily becoming greater, contrast now the opposed Authority. Have the propositions constituting current Theology been rendered more certain with the passage of time and the advance of knowledge, or has the contrary happened? Assyrian and Egyptian records, discovered of late years, have, indeed, served to confirm certain statements contained in the Bible; and so have tended to verify the natural part of the Hebrew story. But this yields no more reason for accepting its supernatural part than does proof that there occurred the

feuds and conquests described in the Norse sagas yield reason for believing in Thor and Odin. Add to which, that if these agreements with Assyrian and Egyptian records tend to verify the Hebrew religion, then, conversely, it might be held by Assyrian and Egyptian priests, did any now exist, that such agreements, verified their religions. Apart, however, from historic statements, thus proved true, investigations, scientific and literary, have served more and more to disprove, or to make doubtful, those parts of the biblical narrative which constitute its Theology. It needs but to contrast past confidence in them with present doubts and disbeliefs, to see that statements of this class have not, like those of Science, become gradually clearer and more certain, but the reverse.* Nor is confidence increased when we ask whether its *guidance* has been successful. After nearly two thousand years of Christian teaching and discipline, how near are we to that ideal life which Christian leading was to bring us to? What must we think of the sentiment implied in the saying of a glorified prince, repeated by a popular emperor, lauding "blood and iron—a remedy which never fails." Among the peoples who socially insist on duels, what advance do we see toward the practice of forgiving injuries? Or, turning from private to public transactions, what restraint do we find upon the passion of international revenge—revenge by the great mass insisted upon as a duty. How much moralization can we trace in the contrast between the practice of savages, whose maxim in their inter-tribal feuds is—"Life for life," and the practice of Christian nations, who in their dealings with weak peoples take as their maxim—"For one life many lives." Toward the foretold state when swords shall be beaten into plowshares, how much have we progressed, now that there exist bigger armies than ever existed before. And where are the indications of increased brotherly love in the doings of Christian nations in Africa, where, like hungry dogs round a carcass, they tear out piece after piece, pausing only to snarl and snap at one another.†

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* Even while I write there comes to me, in *The Academy*, for April 27th, 1895, sufficient illustration in the following remarks, made by a learned biblical critic, the Rev. Prof. Cheyne:—"There is, indeed, no reason, since the Tell-el-Amarna discoveries, to doubt that religious myths of Babylonian origin found their way into Canaan long before the entrance of the Israelites, and were adopted by the Israelitish conquerors; but it may be reasonably held, (1) that the creation-myth in that early age was less developed than that which lies at the root of Gen. i.; (2) that some of its elements had lost much of their life by the time of Amos; (3) that renewed intercourse with Assyria and Babylonia resulted in the revival of the old myth, perhaps with new elements; and (4) that religious teachers in Judah adopted and adapted this and other myths."

† If it be complained that while emphasizing failures in guidance I have ignored successes, by omitting to name the good conduct in private life which has been fostered, I

Clearly, then, by the never-ceasing verification of its *dicta* and by the increasing efficiency and wider range of its guidance, Science is gaining a greater and greater Authority; at the same time that the Authority of Theology is being decreased by the discrediting of its statements and by its unsuccessful regulation of conduct. Hence if Reason, whenever it abdicates in favor of Authority, has to choose between the two, it is compelled to accept the Authority of Science rather than that of Theology, where they are in conflict. So far from strengthening his own position by showing how large a share Authority has, and ought to have, in determining our beliefs, it seems to me that Mr. Balfour strengthens the position of his opponents.

Not unfitly introduced by the foregoing considerations, Mr. Balfour's assault on the fundamental position held by me may now be dealt with. He supposes that he has shown it to be untenable, and is thought to have done so by others. Here are the relevant passages. After describing me as holding that "beyond what we think we know, and in closest relationship with it, lies an infinite field which we do not know, and which with our present faculties we can never know, yet which can not be ignored without making what we do know unintelligible and meaningless," he proceeds:—

"But he has failed to see whither such speculations must inevitably lead him. He has failed to see that if the certitudes of science lose themselves in depths of unfathomable mystery, it may well be that out of these same depths there should emerge the certitudes of religion; and that if the dependence of the 'knowable' upon the 'unknowable' embarrasses us not in the one case, no reason can be assigned why it should embarrass us in the other.

"Mr. Spencer, in short, has avoided the error of dividing all reality into a Perceivable which concerns us, and an Unperceivable which, if it exists at all, concerns us not. Agnosticism so understood he explicitly repudiates by his theory, if not by his practice. But he has not seen that, if this simple-minded creed be once abandoned, there is no convenient halting-place till we have swung round to a theory of things which is its precise oppo-

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reply that, though unquestionably some effect has been produced, there is reason for doubting whether the effect has been great. I have to point out once more, what I have repeatedly pointed out (*Principles of Sociology*, §§ 324, 327, 330–2, 437, 573–4; *Principles of Ethics*, §§ 128, 141, 155, 159, 191), that if we wish to see exemplified in full measure the virtues especially claimed as Christian, we must look among sundry uncivilized peoples classed as Heathens—peoples who do exercise the virtue of forgiveness, whose truthfulness is a proverb, who are absolutely honest, whose goodness is such that in one case it is described as like a romance. The distinctive trait they have in common is that they are perfectly peaceful. We find among them no Christian creed, but only Christian conduct. They do not preach to neighboring tribes an impossible altruism and then treat them with unscrupulous egoism.

site: a theory which, though it shrinks on its speculative side from no severity of critical analysis, yet on its practical side finds the source of its constructive energy in the deepest needs of man, and thus recognizes, alike in science, in ethics, in beauty, in religion, the halting expression of a reality beyond our reach, the half-seen vision of transcendent Truth." (p. 288–9.)

On these passages my first criticism is that they exemplify the process described at the outset—the spearing of an effigy which is alleged to be the reality. For when the doctrine represented as mine is compared with the doctrine which is actually mine, it becomes manifest that Mr. Balfour's spear does not touch it at all. Nowhere have I either directly or indirectly denied that out of the "depths of unfathomable mystery there *may* . . . emerge the certitudes of religion;" and it would be wholly inconsistent with my expressed views were I to deny that there may. The conclusion that by the nature of our intelligence, we are forever debarred from forming any conception of the Reality which lies behind Appearance, has the inevitable corollary that we can assign no limits to the possibilities within it. This I have not only implied, but long ago asserted. Witness the following passage:—

"Though I have argued that, in ascribing to the Unknowable Cause of things such human attributes as emotion, will, and intelligence, we are using words which, when thus applied, have no corresponding ideas; yet I have also argued that we are just as much debarred from *denying* as we are from *affirming* such attributes: since, as ultimate analysis brings us everywhere to alternative impossibilities of thought, we are shown that beyond the phenomenal order of things, our ideas of possible and impossible are irrelevant."—*Nineteenth Century*, July, 1884.

After thus showing that I am unharmed, because untouched, by Mr. Balfour's thrust, I might leave the matter without further remark. But remembering that, much more important than the personal question is the impersonal question lying behind, it seems proper that I should make a counter-attack; for, in opposition to my supposed negation, Mr. Balfour places not only an affirmation but something more than an affirmation. Against my wrongly-assumed assertion that there *may not* emerge, he does not simply put the assertion that there *may* emerge, but he unobtrusively puts the assertion that there *does* emerge. This substituted statement, which he tacitly makes, is a totally different one; and while I admit the *may* I demur to the *does*. Without pausing to ask what is the evidence that there *does*, it will suffice if I examine the proposition itself, and see whether it is a thinkable one—whether the terms in which it is expressed have real meanings, or are merely symbols having no meanings corresponding to them.

Thinking, truly so called, implies mental representation of the

things and processes named; and nearly all incorrect thinking is due to imperfect representation or to non-representation. This is so with thoughts about concrete things, and still more with thoughts about abstract things. If, to an inadequately instructed person, I show a hyperbola and a parabola, and tell him that the sides of the last will obviously meet sooner than the sides of the first, he will not improbably believe my erroneous statement; and, if he does so, it will be because he fails to figure in thought the characters of the two curves. Did he mentally represent them distinctly, he would see that the sides of neither can ever meet. Or if, to such a person I say that, linear dimensions being the same, an eight-sided cube contains more matter than a six-sided cube, he may vaguely think that I am right. If he accepts my false statement, why does he do so? Simply because he has not formed true mental images of the things named. Did he imagine them, or try to imagine them, he would discover that there exists no such thing as an eight-sided cube. Turning to statements about physical phenomena, we have a vivid illustration of sham thinking in the assertion, not unfrequently made concerning some remarkable phenomenon—"Oh, it is caused by electricity:" an assertion which, in both speaker and hearers, leaves a contented feeling that they understand the matter: the truth being that none of them have the remotest idea what electricity is, and none of them have the remotest idea how electricity, did they know its nature, could produce the effect observed. What they take to be their ideas are simply pseud-ideas. And if in the field of sensible experience there is a prevalence of these pseud-ideas, still more widely do they prevail in the fields of theology and metaphysics. Examples are not far to seek.

In Mr. Balfour's proposition that out of the "depths of unfathomable mystery," there "emerge the certitudes of religion," there are two essential elements—that which emerges, and the process of emergence. The primary religious certitude, as implied by his argument, is the existence of "a rational Author" for "the ordered system of phenomena"—an existence which he thinks more certain than the existence of an "independent material world" (p. 237). If, now, the thought of "a rational Author" has emerged out of the "depths of unfathomable mystery," it must, if it is distinguishable from the mere blank form of a thought, have some definable characters; and unless Mr. Balfour considers himself, and men who have similar thoughts, to be fundamentally different from men in general, we must say that thoughts having like characters have emerged into human consciousness at large. I will not ask what happens if we contemplate all the implications, and observe the multitudinous conceptions of gods which the multitudinous races of men have

entertained. It will suffice if I take the conceptions which have arisen in races that have entertained the system of religious beliefs Mr. Balfour defends. Without dwelling on the contrasts between the conceptions of God current in early Hebrew times and those current in later Hebrew times, and without dwelling on the contrasts between the highly anthropomorphic ideas which prevailed in mediæval days throughout Europe and those less anthropomorphic ones which prevail in our days, it will suffice to name, side by side, the diverse conceptions existing among ourselves at present. There is the conceived divine character which most Protestants and all Catholics imply by the belief in an eternal hell; and there is that widely different one implied in the followers of Maurice, who reject that belief. There are the views of Trinitarians and Unitarians, so definitely unlike; and there are two other widely unlike views—that of the Quakers, and that of their fellow Christians who laugh at them for believing that the Christian ideal must be conformed to. Now, if from the "depths of unfathomable mystery" the conception of "a rational Author" of "the ordered system of phenomena" has emerged into human consciousness, there arises in the first place the question—How come there to have so emerged the different conceptions which men have entertained from early days when God was said to have appeared to various persons, down to our late days when theophany is nonsense? Then, seeing that many of these conceptions are in direct antagonism, there arises the question—How are we to decide which must be rejected? And once more, if out of all of them one only has truly emerged, in what manner shall we identify it? To all which unanswerable inquiries add one more. Assuming that the conception of "a rational Author," as existing in Mr. Balfour and those who are on the same high plane of thought, is the only true one, then, if possession of this conception is to be shown, it is requisite that there should be specified some mentally-representable traits which constitute it. And if the asserted traits are unrepresentable—if being, as they must be, abstractions of human attributes existing unlocalized and multiplied by infinity, they are unthinkable—then the assertion of their existence becomes nothing but the blank form of a thought—expresses a pseud-idea.

A kindred result is reached if, not content with the word "emerges," we try to imagine a process answering to that word. The word implies some medium out of which some existence previously concealed gradually appears—at first vaguely and at last distinctly. Can Mr. Balfour say that, apart from any impressions given to him in the course of education and subsequent culture, such a representable emergence has taken place in him? If so, one implication is that his mind differs, not in elevation

only, but in nature, from certain minds which have been so placed as to prevent communication of theological ideas from without; for it has been shown that among deaf-mutes who have received no religious instruction, no idea of God exists.* Hence, in the absence of proof to the contrary, we must say that that high conception of a deity which exists in the minds of Mr. Balfour and others has had an historical origin. By what steps has it been reached? Beginning with the days when, as we are told, God walked in the garden of Eden, there has been a gradual falling away of human attributes—first of all the physical structure and accompanying needs, such as those which Abraham ministered to; then the lower desires and passions which later Hebrew books imply; until through many changes—now reactions toward cruder and coarser ideas, and now advances toward more refined ones—there has been formed the present conception, in which there remain only certain highest intellectual and moral traits, possessed in a degree transcending human imagination. So that, in fact, the movement of thought by which the existing consciousness has been reached is exactly the reverse of the movement alleged by Mr. Balfour. The word "emerges" implies progress from the imperceptible, through the vague, to the distinct; whereas the actual progress has been from the distinct, through the more and more vague, to the imperceptible, or rather to the scarcely conceivable, or literally inconceivable. So that when collated with the implied change, the word "emerges" is also found to stand for a pseud-idea.

The difference between Mr. Balfour's consciousness of that which lies behind Appearance, and the consciousness of those he opposes (or, at least, of such of them as do not assume that there can be Appearance without anything which appears), is that whereas he persists in supposing himself to have thoughts when, under close examination, all the components of thoughts have vanished, they candidly admit that with the vanishing of such components all thoughts have ceased; leaving only a consciousness which can not be put into any form. Not only have they dropped those early conceptions which imply that the Power manifested in thirty millions of suns made a bargain with Abraham—not only have they ceased to believe that such inferior passions as jealousy, anger and revenge can be felt by an Energy which pervades infinity; but they have surrendered themselves to the final conclusion that not even the highest mental attributes conceivable by us, can be predicated of that Existence which fills all Space for all Time.

It is not that they *wish* to do this, but that they *must*: self-

* *Ecclesiastical Institutions*, chapter i.

deception is the alternative. There is no pleasure in the consciousness of being an infinitesimal bubble on a globe that is itself infinitesimal compared with the totality of things.

Those on whom the unpitying rush of changes inflicts sufferings which are often without remedy, find no consolation in the thought that they are at the mercy of forces which cause, indifferently, now the destruction of a sun and now the death of an animalcule. Contemplation of a Universe which is without conceivable beginning or imaginable end and without intelligible purpose yields no satisfaction. The desire to know what it all means is no less strong in the agnostic than in others, and raises sympathy with them. Failing utterly to find any interpretation himself, he feels a regretful inability to accept the interpretation they offer.

STUDIES OF CHILDHOOD.

IX.—FEAR (*continued*).

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IN my last article I gave a general account of children's fears. In this account I purposely reserved for special discussion two varieties of this fear—namely, dread of animals and of the dark. As the former certainly manifests itself before the latter, I will take it first.

It seems odd that the creatures which are to become the companions and playmates of children, and one of the chief sources of their happiness, should cause so much alarm when they first come on the scene. Yet so it is. Many children at least are at first put out by quite harmless members of the animal family. We must, however, be careful in distinguishing between mere nerve-shock and dislike, on the one hand, and genuine fear on the other. Thus a lady whom I know as a good observer tells me that, though when her boy was fifteen months old his nerves were shaken by the loud barking of a dog, he had no real fear of dogs. With this may be contrasted another case, also sent by a good observer, in which it is specially noted that the aversion to the sound of a dog's barking developed late and was a true fear.

Æsthetic dislikes, again, may easily give rise to quasi fears, though, as we all know, little children have not the horrors of their elders in this respect. The boy C—— could not understand his mother's scare at the descending caterpillar. A kind of æsthetic dislike appears to show itself sometimes toward animals

of peculiar shape and color. Black animals, as sheep and cows, seem more particularly to come in for these childish antipathies.

At first it seems impossible to understand why a child in the fourteenth week should appear to shrink from cats.* This is not, so far as I can gather, a common occurrence at this age, and one would like to cross-examine the mother as to the precise way in which the child had its first introduction to the domestic pet. So far as one can speculate on the matter, one would say that such early shrinking from animals is probably due to their sudden unexpected movements, which may well disconcert the inexperienced infant accustomed to comparatively restful surroundings.

This seems borne out by another instance, also quoted by Preyer, of a girl who, in the fourth month, as also in the eleventh, was so afraid of pigeons that she could not bring herself to stroke them. The prettiness of pigeons, if not of cats, ought, one supposes, to insure the liking of children; and one has to fall back on the supposition of the first disconcerting strangeness of the moving animal world for the child's mind.

Later shrinkings from animals show more of the nature of fear. It is sometimes said that children inherit from their ancestors the fear of certain animals. Thus Darwin, observing that his boy, when taken to the zoölogical gardens at the age of two years and three months, showed fear of the big caged animals, whose form was unfamiliar to him (lions, tigers, etc.), infers that this fear is transmitted from savage ancestors whose conditions of life compelled them to shun these deadly creatures. But, as M. Compayré has well shown,† we do not need this hypothesis here. The unfamiliarity of the form, the bigness, together with the awful suggestions of the cage, would be quite enough to beget a vague sense of danger.

So far as I can ascertain, facts are strongly opposed to the theory of inherited fear of animals. Just as in the first months a child will manifest something like recoil from a pretty and perfectly innocent pigeon, so later on children manifest fear in the most unlikely directions. In The Invisible Playmate we are told of a girl who got into her first fright on seeing a sparrow drop on the grass near her, though she was not the least afraid of big things, and on first hearing the dog bark in his kennel said, with a little laugh of surprise, "Oh! coughing."‡ A parallel case is sent me by a lady friend. One day when her daughter was about four years old she found her standing, the eyes wide open and filled with tears, the arms outstretched for help, evidently transfixed with terror, while a small wood louse made its slow way

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* Quoted by Preyer, *op. cit.*, p. 127. The word he uses is "*scheuen.*"

† Evolution intellectuelle et morale de l'Enfant, p. 102.

‡ See pp. 26, 27.

toward her. The next day the child was taken for the first time to the "Zoo," and the mother, anticipating trouble, held her hand. But there was no need. A "fearless spirit" in general, she released her hand at the first sight of the elephant, and galloped after the monster. If inheritance plays a principal part in the child's fear of animals, one would have expected the facts to be reversed. The elephant should have excited dread, not the harmless insect.

As this story tells us, children's shrinkings from animals have much of the caprice of grown-up people's. Not that there is anything really inexplicable in these odd directions of childish fear, any more than in the unpredictable shyings of the horse. If we knew the whole of the horse's history, and could keep a perfect register of the fluctuations of "tone" in his nervous system, we should understand all his shyings. So with the child. All the vagaries of his dislike to animals would be cleared up if we could look into the secret workings of his mind and measure the varying heights of his courage.

That some of this early disquietude at the sight of strange animals is due to the workings of the mind is seen in the behavior of Preyer's boy when at the age of twenty-seven months he was taken to see some little pigs. The boy on the first view looked earnest, and as soon as the lively little creatures began to suckle the mother he broke out into a fit of crying and turned away from the sight with all the signs of fear. It appeared afterward that what terrified the child was the idea that the pigs were biting their mother; and this gave rise in the fourth and fifth year to recurrent nocturnal fears of the biting piglets, something like C——'s nocturnal fear of the wolf.* To an imaginative child strongly predisposed to fear, anything suggestive of harm will suffice to beget a measure of trepidation. A child does not want direct experience of the power of a big animal in order to feel a vague uneasiness when near it. His own early inductions respecting the correlation of bigness and strength, aided as this commonly is by information picked up from others, will amply suffice. To this may be added that the swiftness of movement of the dog, as well as the knowledge soon gained that it can bite, is apt to make this animal especially alarming. So, too, the sudden pouncing down of a sparrow might prove upsetting as suggesting attack; and a girl of four may be quite able to imagine the unpleasantness of an invasion of her dainty person by a small creeping wood louse which, though running slowly, was running toward herself, and so to get a fit of shudders.

It is, I think, undeniable that imaginative children, especially

* See Preyer, *op. cit.*, p. 130.

when sickly and disposed to alarm, are subject to great terror at the thoughts of the animal world. Its very vastness, the large variety of its uncanny and savage-looking forms, appearing oftentimes as ugly distortions of the human face and figure—this of itself, as known from a picture book, may well generate many a vague terror. We know from folklore how the dangers of the animal world have touched the imagination of primitive races, and we need not be surprised that it should make the heart of the wee weakly child to quake. Yet the child's shrinking from animals is less strong than the impulse of companionship which bears it toward them. Nothing is prettier perhaps in child-life than the pose and look of a small boy as he is getting over his trepidation at the approach of a strange big dog and "making friends" with the shaggy monster. The perfect love which lies at the bottom of children's hearts toward their animal kinsfolk soon casts out fear; and when once the reconciliation has been effected it will take a good deal of harsh experience to make the child ever again entertain fear.

Fear of the dark—that is, fear excited by the actual experience or the idea of being in the dark, and especially alone—and the actual dread of dark places, as closets and caves, is, no doubt, very common among children, and seems indeed to be one of their commonly recognized characteristics. Yet it is by no means certain that it is "natural" in the sense of developing itself instinctively in all children.

It is generally agreed that children have no such fear at the beginning of life. A baby of three or four months, if accustomed to a light, may very likely be disturbed at being deprived of it; but this is some way from a dread of the dark.*

Fear of the dark seems to come on when intelligence has reached a certain stage of development. It apparently assumes a variety of forms. In some children it is a vague uneasiness, in others it takes the shape of a more definite dread. A common variety of this dread is connected with the imaginative filling of the dark with the forms of alarming animals, so that the fear of animals and of the dark are closely connected. Thus in one case reported to me a boy between the ages of two and six used at night to see "the eyes of lions and tigers glaring as they walked round the room." The boy C—— saw his *bête noire* the wolf in

* A mother sends me a curious observation bearing on this. One of her children when four months old was carried by her upstairs in the dark. On reaching the light she found the child's face black, her hands clinched, and her eyes protruding. As soon as the child got back to the light she heaved a sigh and resumed her usual appearance. This child was in general hardy and bold and never gave a second display of terror. This is certainly a curious observation, and it would be well to know whether similar cases of apparent fright at being carried in the dark have been noticed.

dark places. Mr. Stevens, in his note on his boy's ideas of the supernatural, remarks that when one year and ten months old he was temporarily seized with a fear of the dark at the time when he began to be haunted by the specter of "Cocky."* It is important to add that even children who have been habituated to going to bed in the dark in the first months are liable to acquire the fear.

This mode of fear is, however, not universal among children. One lady, for whose accuracy I can vouch, assures me that her boy, now four years old, has never manifested a dread of darkness. A similar statement is made by a careful observer, Dr. Sikorski, with reference to his own children.† It seems possible to go through childhood without making acquaintance with this terror, and to acquire it in later life. I know a lady who only acquired the fear toward the age of thirty. "Curiously enough," she writes, "I was never afraid of the dark as a child; but during the last two years I hate to be left alone in the dark, and if I have to enter a dark room, like my study, beyond the reach of the maids from downstairs, I notice a remarkable acceleration in my heart-beat and hurry to strike a light or rush downstairs as quickly as possible."

There is little doubt that when the fear is developed it is apt to become one of the greatest miseries of childhood. We can faintly conjecture, from what Charles Lamb and others have told us about the specters that haunted their nights, what a weighty, crushing terror this may become. Hence, we need not be surprised that the writer of fiction has sought to give it a vivid and adequate description. Victor Hugo, for example, when painting the feelings of little Cosette, who had been sent out alone at night to fetch water from a spring in the wood, says she "felt herself seized by the black enormity of Nature. It was not only terror which possessed her, it was something more terrible even than terror."

Different explanations have been offered of this fear. Locke, who, when writing on educational matters, was rather hard on nurses and servants, puts down the whole of these fears to these wicked persons, "whose usual method is to awe children and keep them in subjection by telling them of Raw Head and Bloody Bones, and such other names as carry with them the idea of something terrible and hurtful, which they have reason to be afraid of when alone, especially in the dark."‡ Rousseau, on the other hand, urges that there is a natural cause. "Accustomed as I am to perceive objects from a distance, and to anticipate their impressions in advance, how is it possible for me, when I

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* Mind, xi, p. 149. † Quoted by Compayré, *op. cit.*, p. 100.

‡ Thoughts on Education, § 138.

no longer see anything of the objects that surround me, not to imagine a thousand creatures, a thousand movements which may hurt me, and against which I am unable to protect myself?" *

Rousseau here supplements and corrects Locke. For one thing, I have ascertained in the case of my own child, and in that of others, that a fear of the dark has grown up when the influence of the wicked nurse has been carefully eliminated. Locke forgets that children can get terrifying fancies from other children and from all sorts of suggestions unwittingly conveyed by the words of respectable grown people. Besides, he leaves untouched the question why children should choose to dwell on these fearful images in the dark rather than on the bright, pretty ones which they also acquire. Mr. R. L. Stevenson has told us how happy a child can make himself at night with such pleasing fancies. Yet it must be owned that darkness seems rather to favor images of what is weird and terrible. How is this? Rousseau gets some way toward answering the question by saying (as I understand him to say) that darkness breeds a sense of insecurity. Not that a child lying in his cot is likely to be troubled that he can not see what is at the other end of the room. I do not think that it is the inconvenience of being in the dark which generates the fear; a child might, I imagine, acquire it without ever having had to explore a dark place.

I strongly suspect that the fear of darkness takes its rise in a sensuous phenomenon, a kind of physical repugnance. All sensations of very low intensity, as very soft vocal sounds, have about them a tinge of melancholy—*tristesse*—and this is especially noticeable in the sensations which the eye experiences when confronted with a dark space, or, what is tantamount to this, a black and dull surface. The symbolism of darkness and blackness, as when we talk of "gloomy" thoughts, or liken trouble to a "black cloud," seems to rest on this effect of melancholy.

Along with this gloomy character of the sensation of dark, and not always easy to distinguish from it, there goes the craving of the eye for its customary light, and all the interest and gladness which come from seeing. When the eye and brain are not fatigued—that is, when we are wakeful—this eyeache may become an appreciable pain; and it is probable that children feel the deprivation more acutely than grown persons, owing to the abundance of their visual activity as well as to the comparatively scanty store of their thought resources. Add to this that darkness, by extinguishing the world of visible things, would give to a timid child tenacious of the familiar home surroundings a

* Émile, Book II.

peculiarly keen sense of strangeness and of loneliness, of banishment from all that it knows and loves. The reminiscences of this feeling, described in later life—as that of Mr. James Payn, in his recently published volume, Gleams of Memory—show that it is the sense of loneliness which oppresses the child in its dark room.

This, I take it, would be quite enough to make the situation of confinement in a dark room disagreeable and depressing to a wakeful child even when in bed and there is no restriction of bodily activity. But this sense of banishment through the blotting out of the familiar scene would not, I take it, amount to a full, passionate *dread* of darkness. It seems to me to be highly probable that a baby of two or three months might feel something of this vague depression and even this craving for the wonted scene, especially just after the removal of a light; yet such a baby, as we have seen, gives no clear indications of fear.

Fear of the dark arises from the development of the child's imagination, and might, I believe, arise without any suggestion from nurse or other children of the notion that there are bogies in the dark. Darkness is precisely the situation most favorable to vivid imagination; the screening of the visible world makes the inner world of fancy bright by contrast. Are we not all apt to shut our eyes when we try to "visualize" or picture things very distinctly? This fact of a preternatural activity of imagination, taken with the circumstance emphasized by Rousseau that in the darkness the child is no longer distinctly aware of the objects that are actually before him, would help us to understand why children are so much given to projecting into the unseen, dark spaces the creatures of the imagination. Not only so—and this Rousseau does not appear to have recognized—the dull feeling of depression which accompanies the sensation of darkness might suffice to give a gloomy and weird turn to the images so projected.

But I am disposed to think that there is yet another element in this childish fear. I have said that darkness gives a positive sensation: we *see* it; and the sensation, apart from any difference of signification which we afterward learn to give to it, is of the same kind that is obtained by looking at a dull, black surface. To the child the difference between a black object and dark, unillumined space is as yet not clear, and I believe it will be found that children tend to materialize, or, to use a rather technical word, "reify"—that is, make a thing of darkness. When, for example, a correspondent tells me that darkness was envisaged by her when a child as a crushing power, I think I see traces of this childish feeling. I seem able to recall my own childish sense of

a big black something on suddenly waking and opening the eyes in a very dark room.

But there is still something else to be noticed in this sensation of darkness. The black field is not uniform, some parts of it showing less black than others, and the indistinct and rude pattern of comparatively light and dark changing from moment to moment, while now and again more definite spots of brightness may form themselves. The varying activity of the retina would seem to account for this apparent changing of the dark scene. What, my reader may not unnaturally ask, has this to do with a child's fear of the dark? If he will recall what was said about the facility with which a child comes to see faces and animal forms in the lines of a cracked ceiling or the veining of a piece of marble, he will, I think, recognize the drift of my remarks. These slight and momentary differences of blackness, these fleeting rudiments of a pattern, may serve as a sensuous base for the projected images: the child's excited fancy sees in these faint differentiations of the black, formless waste definite forms. These will naturally be the forms with which he is most familiar, and since his fancy is tinged with melancholy they will, of course, be gloomy and disturbing forms. Hence we may expect to hear of children seeing the forms of terrifying living things in the dark. Here is an instructive case. A boy of four years had for some time been afraid of the dark, and indulged by having the candle left burning at night. On hearing that the London Crystal Palace had been burned down he asked for the first time to have the light taken away, fear of the dark being now cast out by the bigger fear of fire. Some time after this he volunteered an account of his obsolete terrors to his father. "Do you know," he said, "what I thought dark was? A great, large, live thing, the color of black, with a mouth and eyes." Here we have the "reifying" of darkness, and we probably see the influence of the comparatively bright spots in the attribution of eyes to the monster, an influence still more apparent in the instance quoted above, where a child saw the eyes of lions and tigers glaring as they walked round the room. Another suggestive instance here is that given by M. Compayré, in which a child, on being asked why he did not like to be in a dark place, answered, "I don't like chimney-sweeps."* Here the blackness with its dim suggestions of brighter spots determined the image of the black chimney-sweep with his white flashes of mouth and eyes.† I should like to observe here paren-

* *Op. cit.*, pp. 100, 101.

† It is supposable too that disturbance of the retina giving rise to subjective luminous sensations, as the well-known small bright moving disks, might assist in the case of nervous children in suggesting glaring eyes.

thetically that we still need to learn from children themselves, by talking to them and inviting their confidence when the fear of the dark is first noticed, how they are apt to envisage it.

When imagination becomes abnormally active, and the child is haunted by alarming images, these, by recurring with greatest force in the stillness and darkness of the night, will add to the terrifying associations of darkness. This is illustrated in the case of the boy Stevens, who was haunted by the specter of "Cocky" at night. Dreams, especially the horrible nightmare to which nervous children are subject, may invest the dark with a new terror. A child suddenly waking up, and with open eyes seeing the phantom-object of its dream against the dark background, may be forgiven for acquiring a dread of dark rooms. Possibly this experience gives the clew to the observation already quoted of a boy who did not want to sleep in a particular room because there were so many dreams in it.

If the above explanation of the child's fear of the dark is correct, Rousseau's prescription for curing it is not enough. Children may be encouraged to explore dark rooms and, by touching blindlike the various objects, rendered familiar with the fact that things remain unchanged even when enveloped in darkness —that the dark is nothing but our temporary inability to see things; and this may, no doubt, be helpful in checking the fear when reflection is possible. But a radical cure must go further, must aim at checking the activity of morbid imagination—and here what Locke says about effects of the terrifying stories of nurses is very much to the point—and in extreme cases must set about strengthening shaky nerves.

I have probably illustrated children's fears at sufficient length. Without trying to exhaust the subject I have, I think, shown that fear of a well-marked and intense kind is a common feature of the first years of life, and that it assumes a Protean variety of shapes.

Much more will, no doubt, have to be done in the way of methodical observation, and more particularly statistical inquiry into the comparative frequency of the several fears, the age at which they commonly appear, and so forth, before we can build up a theory of the subject. One or two general observations may, however, be hazarded even at this stage.

The thing which strikes one most, perhaps, in these early fears is how little they have to do with any remembered experience of evil. The child is inexperienced and, if humanely treated, knows little of the acute forms of human suffering. It would seem at least as if he feared, not because experience has made him apprehensive of evil, but because he is constitutionally and instinctively nervous, and possessed with a feeling of insecurity. This

feeling of weakness and insecurity comes to the surface in presence of what is unknown, in so far as this can be brought by the child's mind into a relation to his welfare—as disturbing noises and the movements of things, especially when they take on the form of an approach. The same thing is, as we have seen, illustrated in the fear of the dark. This fact, that children's fears are not the direct product of experience, is expressed otherwise by saying that they are the offspring of the imagination. They are afraid because they fancy things, and it will probably be demonstrated by statistical evidence that the most imaginative children (other things being equal) are the most subject to fear.

In certain of these characteristics, at least, children's fears resemble those of animals. In both alike fear is much more an instinctive recoil from the unknown than an apprehension of known evil. The shying of a horse, the apparent fear of dogs at certain noises, probably, too, the fear of animals at the sight and sound of fire—so graphically described by Mr. Kipling in the case of the jungle beasts—illustrate this. Animals, too, seem to have a sense of the uncanny when something apparently uncaused happens, as when Romanes excited fear in a dog by attaching a fine thread to a bone which he was accustomed to drag about with him and, by surreptitiously drawing it from him, giving to the bone the look of self-movement. The same dog was frightened by soap bubbles. According to Romanes, dogs are frightened by portraits. It is to be added, however, that in animal fears the influence of heredity is clearly recognizable, whereas in children's fears I have regarded it as doubtful.*

Another instructive comparison is that of children's fears with those of savages. Both have a like feeling of insecurity and fall instinctively in presence of a big unknown—e. g., at the first sight of the sea—into the attitude of dread. In the region of superstitious fear more particularly we see how in both a gloomy fancy forestalls knowledge, investing the new or unexplored with alarming traits.

Lastly, children's fears have some resemblance to certain abnormal mental conditions. Idiots, who are so near normal childhood in their degree of intelligence, show a marked fear of strangers. More interesting, however, in the present connection is the exaggeration of the childish fear of new objects which shows itself in certain mental aberrations. There is a characteristic dread of newness, "neophobia," just as there is a dread of water.†

While, however, these are the dominant characteristics of chil-

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* On animal fears, see Romanes, Animal Intelligence, p. 455 f.; Preyer, *op. cit.*, p. 127 ff. and p. 135; Perez, First Three Years of Childhood, p. 64 ff.

† See Compayré, *op. cit.*, pp. 99, 100.

dren's fears, they are not the only ones. Experience begins to direct the instinctive fear impulse from the very beginning. How much it does in the first months of life it is difficult to say. In the aversion of a baby to its medicine glass or its cold bath one sees perhaps more of the rude germ of passion or anger than of fear. Careful observations seem to me to be required on this point, at what definite date signs of fear arising from experience of pain begin to show themselves in the child. Some children at least have a surprising way of not minding even considerable amounts of physical pain—the misery of a fall, a blow, a cut, and so forth, being speedily forgotten. It seems doubtful, indeed, whether the venerable saw, "The burned child dreads the fire," is invariably true. In many cases apparently a good amount of real agony is necessary to produce a genuine fear in a young child.* This tendency to belittle pain is not unknown, I suspect, to the tutor of small boys. It may well be that a definite and precise recalling of the misery of a scratch or even of a moderate burn may not conduce to the development of a true fear, and that here, too, fear, when it arises in all its characteristic masterfulness, is at bottom fear of the unknown. This seems illustrated by the well-known fact that a child will often be more terrified by a first experience of pain, especially if there is a visible hurt and bleeding, than by any subsequent prospect of a renewal of the catastrophe. Is not the same thing true, indeed, of older fears? Should we dread the wrench of a tooth extraction if we experienced it often enough and had a sufficiently photographic imagination to be able to estimate precisely the intensity and duration of the pain?

Much the same thing shows itself in the cases where fear can be clearly traced to experience and association. In some of these it is, no doubt, remembered experience of suffering which causes fear. A child that has been seriously burned will dread a too close approach to a red-hot poker. But in many cases of this excitation of fear by association it is the primary experience of fear itself which is at the bottom of the apprehension. Thus a child who has been frightened by a dog will betray signs of fear at the sight of a kennel, at a picture of a dog, and so forth. The little boy referred to above, who was afraid of the toy elephant that shook its head, showed signs of fear a fortnight afterward on coming across a picture of an elephant in a picture book. In such ways does fear propagate fear in the timid little breast.

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* On this point there are some excellent observations made by Miss Shinn, who points out that physical pain, when not too severe, is apt to be lost sight of in the new feeling of personal consequence to which it gives rise.—Notes on the Development of a Child, Part II, p. 144 ff.

One can not part from the theme of children's fears without a reference to a closely connected subject, the problem of their happiness. To ask whether childhood is a happy time, still more to ask whether it is the happiest, is to raise perhaps a foolish and insoluble question. Later reminiscences are in this case rather treacherous evidence to build upon. Children themselves, no doubt, may have very definite views on the subject. A child will tell you with the unmistakable marks of profound conviction that he is *so* unhappy. But, paradoxical as it may seem, children really know very little about the matter. At the best they can only tell you how they feel at particular moments. To seek for a precise and satisfactory solution of the problem is thus futile. Only rough comparisons of childhood and later life are possible.

In any such comparison the fears of early years claim, no doubt, careful consideration. There seem to be people who have no idea what the agony of these early terrors amounts to. And since it is the unknown that excites this fear—and the unknown in childhood is almost everything—the possibilities of suffering from this source are great enough:

> "Alike the good, the ill offend thy sight,
> And rouse the stormy sense of shrill affright."

George Sand hardly exaggerates when she writes, "Fear is, I believe, the greatest moral suffering of children." In the case of weakly, nervous, and imaginative children, more especially, this susceptibility to terror may bring miserable days and yet more miserable nights.

Nevertheless, it is easy here to pass from one extreme of brutal indifference to another of sentimental exaggeration. Childish suffering is terrible while it lasts, but happily it has a way of not lasting. The cruel, distorting fit of terror passes and leaves the little face with its old sunny outlook. It is not remembered, too, that although children are pitiably fearful in their own way, they are, as we have seen in the case of the little Walter Scott, delightfully fearless also as judged by our standards. How oddly fear and fearlessness go together is illustrated in a story sent me. A little boy fell into a brook. On his being fished out by his mother, his sister, aged four, asked him, "Did you see any crocodiles?" "No," answered the boy, "I wasn't in long enough." The absence of fear of the water itself was as characteristic as the fear of the crocodile.

It is refreshing to find that in certain cases, at least, where older people have done their worst to excite terror, a child has escaped its suffering. Prof. Barnes tells us that a Californian child's belief in the supernatural takes on a happy tone, directing

itself to images of heaven, with trees, birds, and other pretty things, and giving but little heed to the horrors of hell.* In less sunny climes than California children may not perhaps be such little optimists, and it is probable that graphic descriptions of hell fire have sent many a creepy thrill of horror along a child's tender nerves. Still, it may be said that, owing to the fortunate circumstance that children have much less fear of fire than many animals, the imagery in which eternal punishment is wont to be bodied forth does not work so powerfully as one might expect on a child's imagination. Then it is noticeable that children in general are but little affected by fear at the sight or the thought of death. The child C—— had a passing dread of being buried, but his young, hopeful heart refused to credit the fact of that far-off calamity. This, too, is no small deduction to be made from the burden of children's fear.

Not only so, when fear is apt to be excited, Nature has provided the small, timorous person with other instincts which tend to mitigate and even to neutralize it. It is a happy circumstance that the most prolific excitant of fear, the presentation of something new and uncanny, is also provocative of another feeling—that of curiosity, with its impulse to look and examine. Even animals are sometimes divided in the presence of something strange between fear and curiosity;† and children's curiosity is much more lively than theirs. A very tiny child, on first making acquaintance with some form of physical pain, as a bump on the head, will deliberately repeat the experience by knocking its head against something, as if experimenting and watching the effect. A clearer case of curiosity overpowering fear is that of a child who, after pulling the tail of a cat in a bush and getting scratched, proceeded to dive into the bush again.‡ Still more interesting here are the gradual transitions from actual fear before the new and strange to bold inspection. The behavior of one of these small persons on the arrival at his house of a strange dog, of a colored foreigner, Hindu, or some other startling novelty, is a pretty and amusing sight. The first overpowering shyness and shrinking back to the mother's breast, followed by cautious peeps, then by bolder outreachings of head and arms, mark the stages by which curiosity and interest gain on fear and finally leave it far behind. Very soon we know the small, timorous creatures will grow into bold, adventurous lads, loving nothing so much as to probe the awful mysteries of flame and gunpowder and other alarming things.

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* Pedagogic Review, ii, 3, p. 445.

† Some examples are given by Preyer, *op. cit.*, p. 135.

‡ Miss Shinn, *op. cit.*, p. 150.

One palliative of these early terrors remains to be touched on, the instinct of sheltering or refuge-taking. The first manifestations of what is called the social nature of children are little more than the reverse side of their timidity. A baby will cease crying at night on hearing the familiar voice of mother or nurse, because a vague sense of human companionship does away with the misery of the black solitude. A frightened child probably knows an ecstasy of bliss when folded in the protective embrace of a mother's arms. Even the most timid of children never have the full experience of terror so long as there is within reach the secure base of all their reconnoitering excursions, the mother's skirts.

Happy those little ones who have ever near them loving arms within whose magic circle the oncoming of the cruel fit of terror is instantly checked, giving place to a delicious calm!

How unhappy those children must be who, timid and fearsome by Nature, lack this refuge—who are left much alone to wrestle with their horrors as best they may, and are rudely repulsed when they bear their heartquakings to others—I would not venture to say. Still less should I care to suggest what is suffered by those unfortunates who find in those about them not comfort, assurance, support in their fearsome moments, but the worst source of terror. To be brutal to these small, sensitive organisms, to practice on their terrors, to take delight in exciting the wild stare and wilder shriek of terror, this is perhaps one of the strange things which make one believe in the old dogma that the devil can enter into men and women. For here we seem to have to do with a form of cruelty so exquisite, so contrary to the oldest of instincts, that it is dishonoring to the savage and to the lower animals to attempt to refer it to heredity.

To dwell on such things, however, would be to go back to a pessimistic view of childhood. It is undeniable that children are exposed to indescribable misery when they are delivered into the hands of a consummately cruel mother or nurse. Yet one may hope that this sort of person is exceptional—something of which we can give no account save by saying that now and again in sport Nature produces a monster, as if to show what she could do if she did not choose more wisely and benignly to work within the limitations of type.

THOREAU, in relating some of his experiments in making maple sugar—when he got an ounce and a half of sugar from four quarts and a half pint of sap—says that he "had a dispute with father about the *use* of my making this sugar when I knew it could be done, and might have bought sugar cheaper at Holden's. He said it took me from my studies. I said I made it my study, and felt as if I had been to a university."

THE ARMADILLO AND ITS ODDITIES.

By CHARLES H. COE.

THOSE who have seen the armadillo only in pictures, or stuffed specimens in museums, can form but a slight idea how odd and interesting the animal is in life. With an ardent love of natural history, and with exceptional opportunities for indulging my tastes in this direction, I have been the possessor of many pet animals; but none, I can truly affirm, have interested me more by their odd forms and curious habits than a pair of armadillos.

I named my armored pets Jack and Jill, for they are a perfect pair, male and female, now nearly three years old. They were brought from Brazil, having been captured there by men who make it their business, with the aid of native hunters, to secure rare forms of animal life for menageries, zoölogical gardens, and private fanciers.

So rarely are armadillos seen in captivity, and so little has been written about them, that I am sure a reasonably full and detailed description of the animal in general and my pets in particular will prove interesting and instructive.

The armadillo belongs to two different genera, known as *Dasypus* and *Tatusia*, the former name being applied to several South American species, and the latter to those which inhabit North America. They all belong to the order *Edentata*, or toothless animals, which order also includes the sloths and ant-eaters. All these are characterized by the absence of front teeth, while the molars or grinders are not true teeth, being without regular roots or enamel.

Long ages before man appeared upon the earth, as we learn from fossil remains found in its strata, this order was represented by gigantic forms now known as the glyptodon and the megatherium. The former, a huge creature sometimes thirteen feet in length, was related to the armadillo, but its armor was in one solid piece instead of plates and movable bands. The megatherium ("great beast"), a still more enormous animal of the ancient world, was not covered with armor, but was nearly allied to the sloth. It often attained a length of over eighteen feet.

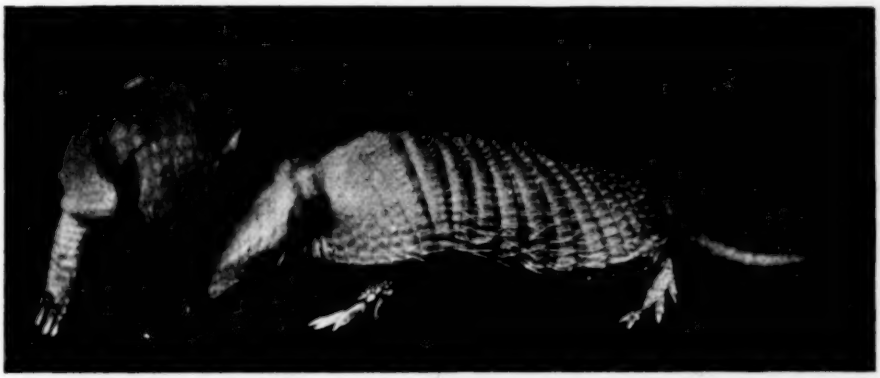
The musical Spanish name *armadillo*, meaning "little armed one," is applied to many species, from the smallest, no larger than a rat, to the giant armadillo, which measures four and a half feet in length from tip to tip, the tail being eighteen inches long.

All the species are confined to the American continent, ranging from southern Texas to the Argentine Republic. Some species inhabit the low coasts of Peru and Chili, others the elevated

plateaus of the Andes, the forests of Brazil, and the barren plains of Central America and Mexico.

From the imperfect structure of its back teeth, which vary in number from twenty-eight to thirty-six, according to the species, and which curiously interlock with each other, it will be seen that the armadillo can only eat the softest food, both animal and vegetable, such as insects, worms, carrion, fruit, and tender roots. Some species are more exclusively vegetarian than others. Those which make the flesh of animals a part of their diet can only eat it after it has become putrid, or, in the case of my pets, after it has been cooked until very tender.

In certain South American countries where cattle are frequently killed for their hides only, and the carcasses left on the ground, the armadillo feasts on putrid flesh. It burrows under a fresh carcass and waits patiently until decay has taken place. It



JACK AND JILL.

then eats its way into the body, finally leaving nothing but the dry bones and skin. In this habit the armadillo resembles certain insects, such as ants and carrion beetles.

The giant armadillo has a still more repulsive habit, sometimes burrowing into human graves when opportunity offers. In such localities graves are commonly protected from the ravages of these ghouls by stones or heavy planks.

The smaller armadillos often enter the nests of ants, but more for the purpose of securing the larvæ than the perfect insects. The tongue, though not long and extensile like that of the true ant-eater, is slender, tapering, and flexible, and can be protruded a short distance from the mouth. It is further adapted for securing insects by a glutinous saliva.

It is amusing to see an armadillo eat, to hear it smack its lips, and to notice its evident enjoyment of its food. Both in its wild state and in captivity it is a hearty eater and often becomes very

fat. The flesh of the animal is highly prized by the natives, but its rank flavor generally repels other residents. It is usually placed upon the table roasted whole, as we prepare a young pig.

On many of the dry and barren plains of Central America the armadillo is the only mammal. There, like the Florida gopher, it shares its burrow with a fellow-tenant, the deadly rattlesnake, which it does not seem to dread in the least. The snake, on the other hand, though it could easily insert its fangs into the armadillo's skin between its bands and plates of armor, seems to know better than to harm its good-natured landlord. Wild creatures often seem thus to tolerate one another's presence, and even to have a friendly understanding which man can not fully comprehend.

The various species of living armadillos differ in the number of movable bands of armor, and are named accordingly. The common species of Central America, Mexico, and southern Texas is the nine-banded armadillo (*Tatusia novemcincta*). My pets, Jack and Jill, belong to the South American species (*Dasypus sexcinctus*), and my description of them will therefore apply to the six-banded armadillo in general.

The two sexes resemble each other closely in size, structure, and outline. The total length of both Jack and Jill is nineteen inches, including the tail, which is six inches. The girth of the body is twelve inches, and it is plump and rounded like that of a puppy or young pig. When the legs are straightened, as in walking, the highest part of the back is six inches from the ground.

The head, three inches and a half in length and conical in shape, is covered above with a single plate of armor which extends on the sides to the eyebrows and lengthwise from a point three quarters of an inch from the end of the nose to a line drawn between the ears. Next behind the ears is a movable transverse band of armor nearly three fourths of an inch in width, separated from the head plate in front of it and from the next band behind it by a narrow space of chocolate-colored, rough, wrinkled, and pliable skin. Following this is another plate over the shoulders, two inches in width at the top, and gradually widening as it extends downward to the neck under the ears.

Now follow one after another the six movable bands from which this species is named. They are all alike, each three fourths of an inch in width, and separated from one another by similar spaces of leathery skin, as above described. Behind these six bands is the posterior plate, four inches wide and ending at the roots of the tail. The tapering tail has four movable bands, followed by a continuous plate extending to the tip.

Besides the armor thus described as protecting the head, back,

sides, and tail, there is a similar coating on the outer surfaces of the legs. The six body bands and the four tail bands are composed of small polygonal pieces, joined together, slightly resembling certain parts of an alligator's skin. The other parts of the armor differ somewhat from these in shape, being more irregular.

It will be seen that the armadillo's protecting coat of mail is by no means firm and immovable like the shell of the tortoise, but is comparatively flexible, thus securing to the animal considerable freedom of movement, quite in contrast to the unwieldy awkwardness of the tortoise. When the armadillo's feet are drawn up under the body, this protecting coat reaches to the ground, overhanging like a cloak lightly thrown over the animal.

We read how the warrior of ancient time, though incased in a heavy coat of mail, was sometimes "pierced between the joints of the harness." A similar fate may befall our "little armed one." Even so puny a creature as the mosquito is enabled to annoy it by attacking the naked skin between the plates and bands. The tiny insect's partiality for this animal is so great, attracted doubtless by the abundant blood coursing through its plump form, that it even follows the armadillo into its burrow on its bloodthirsty errand.

The under parts of the animal, including the chin, breast, belly, and the inner sides of the legs, are covered only by skin. This is of the same color as that between the bands, and resembles in roughness the skin of a plucked chicken, being also naked with the exception of a few scattered hairs. The ears and the end of the nose are also without armor. A few bristly hairs appear on the skin between the bands of armor, and there is quite a tuft under each eye. The hair on the back and sides is pure white; on all other parts, jet black.

The ears are an inch and a quarter in length, round, and always erect. The eyes are small, black, and piggish in expression, with oddly wrinkled lids. The armadillo is chiefly nocturnal in its habits, sleeping much during the day; accordingly, we find the eyes weak and unable to bear strong light. The smell and hearing, on the contrary, are very acute.

The legs are short and stout. Both fore and hind feet have five toes, which are provided with powerful, slightly curved nails from one fourth to one inch long, those on the fore feet being the longest. With these instruments the armadillo not only burrows in the ground with wonderful ease and rapidity, but it can clutch an object, or the earth even, with a powerful grip. In walking on firm ground or on a floor, the nails only of the fore feet touch the surface, and but little more of the hind feet, although the latter are plantigrade when the animal is standing still.

The six-banded armadillo, in common with most of the species,

is one of the most timid and inoffensive of all creatures, not even surpassed in this respect by the guinea pig. It is never known to defend itself, much less to make an assault. The absence of incisors and canine teeth renders it incapable of biting, and it has no offensive odor to warn off molesters. Its strong claws, strange to say, are never used as weapons of combat.

Some species are said to be able to outrun a man, but the six-banded armadillo can not run faster than a man can walk. It has a habit when pursued of quickly dodging and doubling like a rabbit. Failing in all other means of escape, it simply puts its head between its fore feet, tucks its tail and feet away, and rolls itself into a ball, after the common habit of our porcupine and opossum. In this position it may be punched and kicked about with apparently the same freedom from feeling that is displayed by these animals in similar circumstances. Not all of the species, however, resort to this expedient. Some are enabled to expand and flatten their bodies until they lie on the ground extended like a board, somewhat after the habit of the snake known as the spreading adder.

If the armadillo can not reach its burrow before an enemy is upon it, it often escapes by digging its way into the ground—a feat which it is enabled to accomplish in an incredibly short space of time, vanishing before the very eyes of its pursuer. Persons unused to hunting the armadillo sometimes grab its retreating tail, thinking thus to draw out its owner. Failure invariably attends such efforts. The animal simply continues its course into the earth, leaving its tail in the hands of the astonished hunter!

The great strength which thus enables the armadillo to resist withdrawal resides chiefly in its wonderful feet and claws. It simply stiffens its legs and firmly implants its long toe-nails in the ground. The back and sides of the animal are at the same time forced against the top and sides of the burrow, wedging its body in the hole so tightly that six men could scarcely draw it out. It would be like pulling up a sapling tree by its roots. I have noticed a similar bracing movement, by a stiffening of the legs, in the Florida gopher or land tortoise, a creature which has some habits in common with the armadillo.

Hunters have three methods of getting the armadillo out of its hole: by drowning it out, by smoking it out, and by digging. Sometimes all three expedients prove unsuccessful, the rapid burrowing of the animal enabling it to escape. The surest way is to continue digging until the fugitive is exhausted.

Hunters frequently resort to stratagem by taking advantage of the nocturnal habits of the armadillo and capturing it when it emerges from its hole at nightfall. Or they watch near its bur-

row on a moonlight night and pounce upon it suddenly when it returns from a foraging trip. Dogs are often employed to trail the creature when away from its home. When overtaken, of course, it offers not the slightest resistance.

In Central America the armadillo is frequently domesticated to rid houses of insect pests. They also make as nice pets as one could desire; no animal is cleaner or less objectionable about the house. They are as desirable in this respect as well-trained cats or lapdogs, and there could be no higher praise than this.

It is not merely the odd forms and ways of my rare pets that have made them the objects of my peculiar interest. I have been equally charmed with their intelligence and with their evident attachment to myself. If, when they are near me, I suddenly move away from them, they come trotting at my heels in their comical way as fast as their short legs can carry them.

Their gait is always a walk or brisk trot, never a gallop. Most of their movements when in motion resemble those of little pigs. They have learned to answer to their names, and come quickly when called. Curiosity is a prominent characteristic of the animal; if allowed free scope, they will explore every part of a strange place, trying to run their sharp noses into every opening. Much of the daytime is spent in sleeping. In lying down one generally rests its head and fore feet on the neck or back of the other, in a very affectionate manner.

Their attachment for each other is remarkable, all the more noticeable when one becomes separated from the other. If I shut Jack up in a basket, Jill goes round and round outside, at times standing on her hind feet and reaching to the top with her nose. When Jack is finally liberated they put their heads together for a few moments, and then off they go on one of their tours of exploration.

THE spirit of science, said President Brinton at the American Association, is modest in its own claims and liberal to the claims of others. The first lesson which every sound student learns is to follow his facts and not to lead them. New facts teach him new conclusions. His opinions of to-day must be modified by the learning of the morrow. He is at all times ready and willing to abandon a position when further investigation shows that it is probably incorrectly taken. He is in this the reverse of the opinionated man, the hobby-rider, and the dogmatist. The despair of a scientific assemblage is the member with a pet theory, with a fixed idea, which he is bound to obtrude and defend in the face of facts. Yet even toward him we are called upon to exercise our toleration and our charity, for the history of learning has repeatedly shown that from just such wayward enthusiasts solid knowledge has derived some of its richest contributions. So supreme, after all, is energy that error itself, pursued with fervid devotion, yields a more bountiful harvest than truth languidly cultivated.

HERBARIA IN THEIR RELATION TO BOTANY.*

By JOHN P. LOTSY, Ph. D.

THE offer of Captain Donnell Smith to Johns Hopkins University of his valuable herbarium and library gives us an excellent opportunity to consider what such herbaria are, how they are brought together, and what is their purpose. We intend, furthermore, to show what they accomplish in botany and what botany does besides.

The importance of Captain Smith's gift will then be evident, and the value of a well-equipped botanical department to the Johns Hopkins and to the community at large will also be clear. The references to flowers and trees in ancient poems show that the beauty of vegetable Nature was fully appreciated at an early period, and agriculture requires the rudiments of a scientific knowledge of plants; but the first systematic attempts to study botany scientifically owe their origin to the desire to know more of plants in their relation to medicine. There are few plants which have not at some time been supposed to have great medicinal value, as the number of those designated *officinalis* clearly indicates.

The first systematic study of plants in their relation to medicine was in the Athenian Republic, and Theophrastus, Dioscorides, Pliny, and Galen are especially known for their writings on this subject. During the middle ages the science of the Greeks was forgotten, and interest in their investigations was not revived till the sixteenth century. By this time the old Greek texts had become greatly obscured by imperfect translations, and it required much patience and care to recognize plants from their descriptions. The botanists of the sixteenth century, like Bock, Fuchs, and Mattioli, working in Germany, found another difficulty in the circumstance that plants of their country differed widely from those in Greece. This, together with the imperfect state of the old descriptions, gave rise to frequent mistakes in identification. Some other authors, however, would notice the error, and disputes often arose, which sometimes became violent. The great value of this work to us is that it showed the necessity for more exact descriptions of plants, and this, combined with the occasional finding of new plants of a supposed or real value to medicine, gave rise to those large parchment-bound, queer-looking old volumes on botany which, besides the descriptions, often contained very beautiful pictures of the plants. These were then called

* Read before the Scientific Association of the Johns Hopkins University, February 21, 1894.

herbaria, a significance being given to the word which it has now lost. It soon became painfully evident that very good and conscientious descriptions, even when accompanied by accurate plates, were yet not adequate to express all those delicate details which the living plant showed. So some of the authors found a way to keep the plants they had described, at first for their own reference, and for this purpose dried them carefully, glued them on sheets of paper, and put the name on this paper. Preserved in this way and arranged alphabetically for easy reference, these specimens formed a supplementary confirmation of their descriptions which was readily accessible. This was what we now call a *herbarium*—in other words, a collection of well-preserved, carefully named dry plants. If the description of an author who had a collection of this sort was called in question, it was an easy thing for him to send his original plant to some third botanist, who could decide whether he was right. Afterward it was recognized by those who described new plants that it would be of great importance to them if they could have the originals of the descriptions of their fellow-botanists. So a system of interchange of originals arose, which is now carried on between botanists all over the world. A trained and competent botanist who finds an opportunity to study the flora of regions which are little known may by this means become possessed of all the most instructive and remarkable plants that are known to science.

So a modern botanist no longer collects, as was formerly done, only one or two samples of every plant, but one or two hundred—of rare species often two thousand—because every specimen he has will enable him to obtain some new one in exchange.

The difficulties of collecting in the present time may be estimated from this. To collect four thousand plants in a tropical climate means not only to find, dry, and name these under the most unfavorable conditions, but to prepare perhaps forty thousand, all the duplicate specimens being used in exchange.

For a long while plants were named by any word which took the fancy of its author, and were arranged in the alphabetical order of the names. Soon, however, it was found that a better disposition was desirable, as nobody could look over such extensive alphabetically arranged collections, and students began to assort the plants in such a way that those which had certain characteristics in common were grouped in classes. So, for example, all kinds of grasses, all kinds of trees, all kinds of shrubs were put together, etc. Such a beginning of classification and unconscious recognition of relationship was begun by Lobelius and Bauhin, extended by Cæsalpin, and completed by Linnæus.

Linnæus, besides, saw the necessity of bringing together all the descriptions of plants already existing, and of wording them in such a way that, without losing anything essential in the description, they should occupy the smallest possible space. Such a condensed description is now known as a diagnosis.

When he had accumulated a considerable number of diagnoses he saw that it was difficult to find one's way through them, and he set about arranging them after some of the most striking characteristics which did not necessarily indicate relationship, but were simply as a means of classification and recognition. He took for this first the number of stamens, bringing all plants with one stamen in the flower together, all with two, three, four, five, ten, etc., into their several classes, in this way creating the groups of the *Monandra, Decandra, Polyandra,* etc.

Having done this, he recognized that a subdivision of these groups was desirable; that many plants with the same number of stamens yet differed considerably among one another; and these smaller groups he called *genus,* plural *genera.* Such a genus now, for example, is the buttercup, which he called *Ranunculus.* He saw that further subdivision could take place, and that there were a great many plants which, though evidently all buttercups, yet differed sufficiently to be distinct. So he resolved to give every plant two names, the first one being the genus name, here *Ranunculus,* the second one expressing some property of that particular kind of *Ranunculus,* and thus indicating the species. Thus he found, for example, that one buttercup had an acrid taste, and he called it the acrid buttercup—in Latin, *Ranunculus acris;* that another one always grew on marshy places; he called it the marsh buttercup—in Latin, *Ranunculus palustris,* etc.

Latin names were used simply as a matter of convenience, as it was much easier to know one Latin name than a dozen names in a dozen different languages for the same plant. Linnæus's system was consequently one of mere convenience and thoroughly artificial.

It had, however, already been recognized that certain plants belong naturally together, as grasses, for example, while Linnæus's system often placed two grasses very far apart. This conception of relationship, however, could not be expressed well before Darwin had shown that plants had not always been as they are now, but that the higher plants had gradually been developed from the lower ones. Then an entirely different system arose—a system which expressed the relation of plants in the way of a genealogical tree; this system is generally known under the name of the natural system. It is after this natural system, which expresses our conception of the blood relation between the different plants, that our present herbaria are arranged,

and it is their object to show us at all times not only the plants described, but also the family relation between these different plants.

In Linnæus's time a botanist was regarded as somebody who could name at sight any plant presented to him, and the best botanist was the one who was most proficient in this. We are justified, however, in requiring a few other things from a good botanist. The recognition of the family relations between different plants gave rise to the comparing of their different organs, to the study of their development, to inquiring what conditions had influenced an organ in such a way that it became modified, to the search for the equivalents of the organs of the higher plants among the lower ones; all of which constitute that branch of botany which now is known as morphology.

The recognition of yet finer details created our histology.

The closer acquaintance with plants induced scientific men to observe their habits, their distribution, and how they lived; and this is plant physiology in its widest sense.

For the study of the botanical system, morphology, and geography, a herbarium like that of Captain Smith is of the greatest advantage. For physiological purposes, quite other things—as exact instruments, hothouses to keep living plants, etc.—are necessary.

Physiology is that part of botany which has had most practical value. The fertilizing with artificial manures is entirely founded upon it, for it never could have become known if careful experiments in the laboratory had not shown what substances were necessary to each particular kind of plant. Consequently, all agricultural experiment stations are practically based on plant physiology.

This plant physiology, or the science of the normal life of the plant, gave rise to the study of the plant under abnormal—in other words, diseased—conditions, and so the science of plant pathology, on which our knowledge of the diseases of our crops and the way to prevent or cure them is based.

Last, and not least, the study of those very smallest plants, the bacteria, made an enormous change in our treatment of sick human beings; the study of the parasitic molds has done an important service to our fish industries; so the influence of modern scientific botany is felt in fields that seem to the casual observer to have no connection with vegetation, and the scope of this science is no longer confined to what for years was its only object—the naming of plants.

PROFESSIONAL INSTITUTIONS.

III.—DANCER AND MUSICIAN.

By HERBERT SPENCER.

IN an essay on The Origin and Function of Music, first published in 1857, I emphasized the psycho-physical law that muscular movements in general are originated by feelings in general. Be the movements slight or violent, be they those of the whole body or of special parts, and be the feelings pleasurable or painful, sensational or emotional, the first are always results of the last: at least, after excluding those movements which are reflex and involuntary. And it was there pointed out that, as a consequence of this psycho-physical law, the violent muscular motions of the limbs which cause bounds and gesticulations, as well as those strong contractions of the pectoral and vocal muscles which produce shouting and laughter, become the natural language of great pleasure.

In the actions of lively children who, on seeing in the distance some indulgent relative, run up to him, joining one another in screams of delight and breaking their run with leaps, there are shown the roots from which simultaneously arise those audible and visible manifestations of joy which culminate in singing and dancing. It needs no stretch of imagination to see that when, instead of an indulgent relative met by joyful children, we have a conquering chief or king met by groups of his people, there will almost certainly occur saltatory and vocal expressions of elated feeling, and that these must become, by implication, signs of respect and loyalty—ascriptions of worth which, raised to a higher power, become worship. Nor does it need any stretch of imagination to perceive that these natural displays of joy, at first made spontaneously before one who approaches in triumph as a benefactor and glorifier of his people, come, in course of time, to be observances used on all public occasions as demonstrations of allegiance; while, simultaneously, the irregular jumpings and gesticulations with unrhythmical shouts and cries, at first arising without concert, gradually by repetition become regularized into the measured movements we know as dances and into the organized utterances constituting songs. Once more, it is easy to see that out of groups of subjects thus led into irregular ovations, and by and by into regular laudatory receptions, there will eventually arise some who, distinguished by their skill, are set apart as dancers and singers, and presently acquire the professional character.

Before passing to the positive evidence which supports this in-

terpretation, it may be well to remark that negative evidence is furnished by those savages who have no permanent chiefs or rudimentary kings; for among them these incipient professional actions are scarcely to be traced. They do indeed show us certain rude dances with noisy accompaniments; but these are representations of war and the chase. Though the deeds of celebrated warriors may occasionally be simulated in ways implying laudation of them, there do not commonly arise at this stage the laudations constituted by joyous gesticulations and triumphant songs in face of a conqueror. At later stages ceremonies of this primitive kind develop into organized exercises performed by masses of warriors. Thus among the Kaffirs the war-dances constitute the most important part of their training, and they engage in these frequently; and it is said that the movements in the grand dances of the Zulus resemble military evolutions. So, too, Thomson writes that the war-dance of the New Zealanders approximated in precision to the movements of a regiment of European soldiers. Clearly it is not from these exercises that professional dancing originates.

That professional dancing, singing, and instrumental music originate in the way above indicated, is implied by a familiar passage in the Bible. We are told that when David, as general of the Israelites, "was returned from the slaughter of the Philistines"—

> "The women came out of all cities of Israel singing and dancing to meet king Saul with tabrets, with joy, and with instruments of music; and the women answered one another as they played, and said 'Saul hath slain his thousands and David his ten thousands'" (I Sam., xviii, 6, 7).

Here the primitive reception of a conquering chief by shouts and leaps, which has, along with semi-civilization, developed into more definite and rhythmical form, vocal and saltatory, is accorded both to a reigning conqueror and to a conqueror subordinate to him. But while on this occasion the ceremony was entirely secular, it was, on another occasion, under different circumstances, predominantly sacred. When, led by Moses, the Israelites had passed the Red Sea, the song of Miriam, followed by the women "with timbrels and with dances" exhorting them "sing ye to the Lord, for he hath triumphed gloriously," shows us the same kind of observance toward a leader (a "man of war," as the Hebrew god is called) who is no longer visible, but is supposed to guide his people and occasionally to give advice in battle. That is, we see religious dancing and singing and praise having the same form whether the object of them is or is not present to sight.

Usages which we find in existing semi-civilized societies, justify the conclusion that ovations to a returning conqueror, at first

spontaneous expressions of applause and loyalty, gradually pass into ceremonial observances used for purposes of propitiation. It becomes the policy to please the ruler by repetitions of these songs describing his great deeds, and of the dances expressive of joy at his presence. Describing the Marutse, Holub says:—

"All the musicians [of the royal band] were obliged to be singers as well, having to screech out the king's praises between the intervals in the music, or to a muffled accompaniment of their instruments."

So, Schweinfurth tells us that at the court of king Munza, the Monbutto ruler, there were professional musicians, ballad-singers, and dancers, whose leading function was to glorify and please the king. And in Dahomy, according to Burton, "the bards are of both sexes, and the women dwell in the palaces . . . the king keeps a whole troop of these laureates." Official praises of this kind are carried on by attendants not only of the king but of subordinate rulers. In processions in Ashantee, "each noble is attended by his flatterers, who proclaim, in boisterous songs, the 'strong names' of their master;" and on the Gold Coast, "every chief has a horn-blower, and a special air of his own." Similarly we learn from Park that among the Mandingos there are minstrels who "sing extempore songs in honor of their chief men, or any other persons who are willing to pay them:" showing us an unobtrusive divergence from the original function. Winterbottom indicates a like divergence.

"Among the Foolas there is a set of people called singing men, who, like the ancient bards, travel about the country singing the praises of those who choose to purchase renown."

Passing beyond Africa we read that in Madagascar "the sovereign has a large band of female singers, who attend in the courtyard, and who accompany their monarch whenever he takes an excursion." Raffles, too, says that in Java there are three classes of dancing-girls, who perform in public: 1. The concubines of the sovereign and of the hereditary prince. These are the most skillful. 2. The concubines of the nobles. 3. The common dancing girls of the country. In these cases we are shown that while saltatory and vocal forms of glorification, at first occasional and spontaneous, have become regular and ceremonial; and while those who perform them, no longer the people at large, have become a specialized class; two further changes have taken place. Instead of being both singers and dancers, as the primitive celebrants were, these permanent officials have become differentiated into the two classes, singers and dancers; and, if not of the singers, yet of the dancers we may remark that their performances, ceasing to be expressions of welcome and joy before the ruler, have grown into displays of agility and grace, and are gone through

for the purpose of yielding æsthetic pleasures. Among the Hebrews this development had taken place in the time of Herod, when the daughter of Herodias delighted him by her dancing; and a like development is shown at the present day throughout India, where troops of bayaderes are appendages of courts.

That laudatory dancing and singing before the visible ruler are associated with like observances before the invisible ruler, the Hebrews have shown us. To the case of the prophetess Miriam and her companions, may be added the case of David dancing before the ark. Hence we shall not be surprised to find such facts among other semi-civilized peoples. Markham, describing a Puharrie festival, and saying of a certain receptacle that "in it the Deity is supposed to dwell," adds that "upon this occasion the deptha, or ark, is brought forth with much solemnity, and the people decked out with flowers and ears of corn dance around it." In an account of the Bhils we read, concerning a class of men called *Barwás* who are votaries of the hill-gods, that—

"Their powers are, however, dormant, till they are excited by music; and for this reason, they have a class of musicians connected with them, who are proficient in numerous songs in praise of the hill-deities. When the recitation of these songs has kindled the spark of spiritual fire, they begin to dance with frantic gestures."

An analogous use of dancing occurs in Abyssinia. The duties of priests "consist in reading the prayers, chanting, administering the sacrament, and dancing; the latter being indulged in during religious processions." That the dancing is in this case imported into the quasi-Christian religion by adoption from some previous religion (a like adoption being common with Roman Catholic missionaries) is a conclusion supported by an instance from a remote region. Describing the usages of the Pueblos, Lummis says:—

"The *cachinas* or sacred dances which were in vogue before Columbus, still survive; but now they are applied to the festivals of the Church, and are presumed to be as grateful to *Tata Dios* as to the Sun."

But the way in which singing and dancing before the visible ruler differentiate into singing and dancing before the ruler no longer visible, is best seen in the early records of civilized races. To the above illustrations furnished by Hebrew history may be added various others. Thus I Samuel x, 5, tells of "a company of prophets coming down from the high place with a psaltery, and a tabret, and a pipe, and a harp before them;" and, according to some translators, dancing and singing. Again in I Chronicles ix, 33, we read of certain Levites that "these are the singers, chief of the fathers of the Levites." And in Psalm cxlix, there is the ex-

hortation:—"Let them praise his name in the dance: let them sing praises unto him with the timbrel and harp:" worship which was joined with the execution of "vengeance upon the heathen."

This association of dancing and singing as forms of worship, and by implication their more special association with the priesthood, is not so conspicuous in the accounts of Egypt; probably because the earlier stages of Egyptian civilization are unrecorded. According to Herodotus, however, in the processions during the festival of Bacchus, the flute-player went first and was followed by the choristers who chanted all the praises of the deity. Naming also cymbals and flutes and harps as used "in religious ceremonies;" Wilkinson says that "the sacred musicians were of the order of priests and appointed to the service, like the Levites among the Jews." Songs and clapping of hands are mentioned by him as parts of the worship. Moreover the wall-paintings yield proofs. "That they also danced at temples, in honor of the gods, is evident from the representations of several sacred processions." Wilkinson is now somewhat out of date, but these assertions are not incongruous with those made by later writers. The association between the temple and the palace was in all ways intimate, and while, according to Brugsch, one steward of the king's household "was over the singing and playing," Duncker states that "in every temple there was a minstrel." So too, Tiele, speaking of Im-hotep, son of Ptah, says—

"The texts designate him as the first of the Cher-hib, a class of priests who were at the same time choristers and physicians."

But Rawlinson thinks that music had, in the days of historical Egypt, become largely secularized:—"Music was used in the main as a light entertainment . . . The religious ceremonies into which music entered were mostly of an equivocal character."

Similar was the genesis which occurred in Greece. A brief indication of the fact is conveyed by the statement of Guhl and Koner that all the dances "were originally connected with religious worship." The union of dancing and singing as components of the same ceremony, is implied by Moulton's remark that—

"'Chorus' is one example amongst many of expressions that convey musical associations to us, but are terms originally of dancing. The chorus was the most elaborate of the lyric ballad-dances."

And that the associated use of the two was religious is shown by the description of Grote, who writes:—

"The chorus, with song and dance combined, constituted an important part of divine service throughout all Greece. It was originally a public manifestation of the citizens generally . . . But in process of time, the per-

formance at the chief festival tended to become more elaborate and to fall into the hands of persons expressly and professionally trained."

In like manner Donaldson tells us "that music and dancing were the basis of the religious, political, and military organization of the Dorian states:" remarking also that—

"The preservation of military discipline and the establishment of a principle of subordination, not merely the encouragement of a taste for the fine arts, were the objects which these rude legislators had in view; and though there is no doubt that religious feeling entered largely into all their thoughts and actions, yet the god whom they worshiped was a god of war, of music, and of civil government."

On which statement, however, we may remark that it contains a species of error common in historical interpretations. It is erroneously assumed that these dances were introduced by legislators, instead of being continuations of observances which arose spontaneously. How in Greece there early began the secularization of music is shown by the traditions concerning the religious festivals —the Pythian, Olympian, etc.—which presently furnished occasions for competitions in skill and strength. The Pythian games, which were the earliest, exhibited the smallest divergence from the primitive purpose; for only musical and poetical contests took place. But the establishment of prizes shows that out of the original miscellaneous chorus had arisen some who were marked by their more effective expressions of praise and finer vocal utterances. And on reading that out of those who played accompaniments to the sacred songs and dances, some became noted for their skill, and that there presently followed at the great Greek games prizes to the best performers on flutes, trumpets, and lyres, we see how there arose also that differentiation of instrumentalists from vocalists which presently became pronounced. Says Mahaffy concerning a performance about 250 B. C.—

"This elaborate instrumental symphony was merely the development of the old competitions in playing instruments, which had existed at Delphi from very early days."

Hence, after a time, a complete secularization of music. Besides musical performances in honor of the gods, there grew up in later days performances which ministered solely to æsthetic enjoyments. Distinguishing the sacred from the secular, Mahaffy says the first "were quite separate from the singing and playing in private society, which were cultivated a good deal at Athens, though not at all at Sparta, where such performances were left to professional musicians."

Parallel evidence is furnished by Roman history. We read in Mommsen that—

"In the most ancient religious usages dancing, and next to dancing instrumental music, were far more prominent than song. In the great procession, with which the Roman festival of victory was opened, the chief place, next to the images of the gods and the champions, was assigned to the dancers, grave and merry. . . . The 'leapers' (*salii*) were perhaps the most ancient and sacred of all the priesthoods."

So, too, Guhl and Koner write:—

"Public games were, from the earliest times, connected with religious acts, the Roman custom tallying in this respect with the Greek. Such games were promised to the gods to gain their favor, and afterward carried out as a sign of gratitude for their assistance."

Congruous with this statement is that of Posnett, who, after quoting an early prayer to Mars, says—

"This primitive hymn clearly combined the sacred dance . . . with the responsive chant; and the prominence of the former suggests how readily the processional or stationary hymn might grow into a little drama symbolizing the supposed actions of the deity worshiped."

Here we see a parallelism to the triumphal reception of David and Saul, and are shown that the worship of the hero-god is a repetition of the applause given to a conqueror when alive in celebration of his achievements: the priests and people doing in the last case that which the courtiers and people did in the first. Moreover in Rome, as in Greece, there eventually arose, out of the sacred performances of music, secular performances—a cultivation of music as a pleasure-giving art. Says Inge—

"In republican days a Roman would have been ashamed to own himself a skilled musician. . . . Scipio Æmilianus delivered a scathing invective in the senate against schools of music and dancing at one of which he had even seen the son of a Roman magistrate."

But in the days of the Cæsars musical culture had become part of a liberal education; and we have, in illustration, the familiar remembrance of Nero as a violinist. At the same time "trained choirs of slaves were employed to sing and play to the guests at dinner, or for the delectation of their master alone."

On tracing further the evolution of these originally twin professions, we come upon the fact that while, after their separation, the one became almost wholly secularized, the other long continued its ecclesiastical connections and differentiated into its secular forms at a later date. Why dancing ceased to be a part of religious worship, while music did not, we may readily see. In the first place dancing being inarticulate, is not capable of expressing those various ideas and feelings which music, joining with words, is able to do. As originally used it was expressive of joy, alike in presence of the living hero and in the supposed presence of his

spirit. In the nature of things it implies that overplus of energy which goes along with elated feeling, and does not serve to express the awe, the submission, the penitence, which form large parts of religious worship in advanced times.

Naturally then dancing, though it did not in the middle ages wholly disappear from religious worship, practically fell into disuse. One part only of the original observance survived—the procession. Alike in the triumphal reception of a returning conqueror and in the celebration of a god's achievements, the saltatory actions were the joyous accompaniments in a moving stream of people. But while the saltatory actions have ceased the moving stream has continued. Moreover there have survived, even down to our own day, its two original forms. We have religious processions, now along the aisles of cathedrals and now through the streets; and besides other secular processions more or less triumphal, we have those in which either the ruler or the representative of the ruler is escorted into the city he is approaching by troops of officials and by the populace: the going out to meet the judges, who are the king's deputies, shows us that the old form *minus* the dance is still extant.

A further fact is to be noted. While dancing has become secularized it has in part assumed a professional character. Though, even in the earliest stages, it had other forms and purposes than those above described (as shown in the mimetic representations of success in the chase, and in primitive amatory dances), and though from these, secular dancing has been in part derived; yet if we bear in mind the transition from the dancing in triumphal processions before the king, to dancing before him as a court-observance by trained dancers, and from that to dancing on the stage, we may infer that even the forms of secular dancing now familiar are not without a trace of that origin we have been following out.

Returning from this parenthesis and passing from the evidence furnished by ancient civilizations to that furnished by the pagan and semi-civilized peoples of Europe, we may first note the statement of Strabo concerning the Celts.

> There "are generally three divisions of men especially reverenced, the Bards, the Vates, and the Druids. The Bards composed and chanted hymns; the Vates occupied themselves with the sacrifices and the study of nature; while the Druids joined to the study of nature that of moral philosophy."

And the assertion is that these bards recited the exploits of their chiefs to the accompaniment of the harp. The survival of pagan observances into Christian times probably gave origin to the class

distinguished among the Scandinavians as "skalds" and among the Anglo-Saxons as harpers and gleemen. Thus we read:—

"The gleemen added mimicry . . . dancing . . . tumbling, with sleights of hand. . . . It was therefore necessary for them to associate themselves into companies."

"Soon after the conquest these musicians lost the ancient Saxon appellation of gleemen and were called ministraulx, in English minstrels."

Moreover in the old English period the minstrel "was sometimes a household retainer of the chief whom he served, as we see in the poem of Beowulf." And since it was the function of the minstrel now to glorify his chief and now to glorify his chief's ancestors, we see that in the one capacity he lauded the living potentate as a courtier, and in the other capacity he lauded the deceased potentate as a priest lauds a deity.

While, with the decay of the worship of the pagan gods, heroes, and ancestors, some music became secularized, other music began to develop in connection with the substituted religion. Among the Anglo-Saxons, "music was also cultivated with ardor. . . . Permanent schools of music were finally established in the monasteries, and a principal one at Canterbury. So, too, was it under the Normans: "great attention was now paid to Church music, and the clergy frequently composed pieces for the use of their choirs." And then in the fifteenth century—

"Ecclesiastical music was studied by the youths at the Universities, with a view to the attainment of degrees as bachelors and doctors in that faculty or science, which generally secured preferment."

But the best proof of the clerical origin of the musical professor during Christian times, is furnished by the biographical notices of early musicians throughout Europe. We begin in the fourth century with St. Ambrose, who set in order "the ecclesiastical mode of saying and singing divine service;" and then come to St. Gregory who in 590 arranged the musical scales. The tenth century yielded Hucbaldus, a monk who replaced the two-lined stave by one of more lines; and the eleventh century the monk Guido d'Arezzo, who further developed the stave. A differentiation of sacred into secular was commenced in the twelfth century by the Minnesingers: "their melodies were founded on the Church scales." Developed out of them, came the Meistersingers, who usually performed in churches, and "had generally a sacred subject, and their tone was religious." "One of the first composers who wrote in regular form" was Canon Dufay of the Cathedral of Cambrai in 1474. The sixteenth century brought Lasso, who wrote thirteen hundred musical compositions, but whose *status* is not named; and then, showing a pronounced secularization, we have, in the same century, Phillipus de Monte, Canon of Cambrai,

who wrote thirty books of madrigals. About that time Luther, too, "arranged the German mass." In the next century we have the distinguished composer Palestrina who, though originally a layman, was elected to priestly functions; and the priest, Allegri, a chorister and composer. At later dates lived Carissimi, chapel-master and composer; Scarlatti also *maestro di capella*. France presently produced Rameau, church-organist; and Germany two of its greatest composers—Handel first of all capellmeister in Hanover and then in England; and Bach, who was primarily an organist, and who, "deeply religious," developed "the old Church modes" into modern forms. Among other leading musicians of the eighteenth century were Padre Martini, and Zingarelli, both chapel-masters; and there flourished during the same period the Abbé Vogler, and Cherubini, a chapel-master. To all which cases abroad should be added the cases at home. Beginning in 1515 with Tallis "the father of English Cathedral Music," we find him called "gentleman (chorister) of the Chapel Royal." In the same century comes Morley, chorister, "epistler," and "gospeller," who, thus semi-priestly, composed secular music; Byrd, a similar functionary similarly characterized; Farrant, also clerical in character; and a little later Gibbons, an organist but largely a writer of secular music. In the next century we have Lawes, "epistler" of the Chapel Royal composer of sacred music; Child, chorister, organist, and sacred composer; and Blow, the same. Then come the four generations of Purcells, all connected with the Church as choristers and organists; Hilton, organist and parish clerk, and writer of secular as well as sacred music; and Croft, organist, chief chorister, and composer, secular and sacred. And so with later composers, Boyce, Cook, Webbe, Horsley, who, still in part Church-functionaries, are chiefly known by their songs, glees, and catches.

We must not, however, ignore the fact that though out of the cultivation of music for purposes of worship, music of the more developed kinds originated, there independently grew up simple popular music; for from the earliest times emotions excited by the various incidents of life have prompted spontaneous vocal expression. But recognition of this truth consists with assertion of the larger truth that the higher developments of music in modern times, arose out of elaborated religious worship, and were for a long time the productions of the priest-class; and that out of this class, or semi-secularized members of it, there were eventually differentiated the composers and professors of secular music.

One further differentiation which has accompanied the last has to be noted. The musician's art, developed by the priestly class in the service of the church, and gradually influencing the simple secular music existing among the people, began to evolve

out of this the higher forms of music we now know. Whether or not the popular dances in use during recent centuries had arisen *de novo*, or whether, as seems more probable, they had descended with modifications from the early dance-chants used in pagan worship, inquiry discloses the remarkable fact that out of them have grown the great orchestral works of modern days. The *suites de pièces* of Bach and Handel were originally sets of dances in different times; and these have developed into the successive movements of the symphony, which even now, in the occasional movement named "minuet," yields a trace of its origin. And then, along with these developments of music, has taken place one further differentiation—that of composer from performer. Though some performers are also composers, yet in large measure the composer has become an independent artist who does not himself, unless as conductor, take part in public entertainments.

In this case, as in other cases, the general process of evolution is exemplified by the integration which has accompanied differentiation. Evidence furnished by ancient civilizations must be postponed to the next chapter as more closely appertaining to it. Here we may content ourselves with indicating the illustrative facts which modern days furnish.

Beyond the unorganized body of professed musical performers and beyond the little-organized body of professors and teachers of music, there is the assemblage of those who, having passed examinations and acquired degrees in music, are marked off more distinctly: we see the increased definiteness which accompanies integration. There are also the multitudinous local musical societies; the local musical festivals with their governing organizations; and the several incorporated colleges, with their students, professional staffs, and directors.

Then as serving to unite these variously-constituted groups of those who make the musical art a profession, and of those who give themselves to the practice of it as amateurs, we have a periodical literature—sundry musical journals devoted to reports and criticisms of concerts, operas, oratorios, and serving to aid musical culture while they maintain the interests of the teachers and performers.

THE curious fact is noticed by Prof. Basil Hall Chamberlain that in the Japanese Archipelago vegetation diminishes instead of increasing in rankness as one travels south. In Yezo the summer grasses and tall weeds are higher than the head of a horseback rider; in central Japan the grass is seldom taller than a man on foot; in Great Luchu everything is much lower still. There are no tall grasses, comparatively few bamboos, and few thickets of any sort. The country is parklike.

A MEDICAL STUDY OF THE JURY SYSTEM.

By T. D. CROTHERS, M. D.

THE uncertainty of jurors, and the capricious, whimsical character of their verdicts, are accepted as inevitable, and explained as part of the natural weakness of the mind. It is assumed that, if the facts are clearly presented, a jury will give a common-sense verdict, which will approximate the truth and human justice. Where they fail, it is due to the confusion of testimony, the misrepresentation of counsel, and the general perversion of facts. Many thoughtful men consider the judgment of twelve men, who are disinterested, superior and on general matters of dispute of far more reliable character than the judgment of one trained man. Yet literally, the verdicts of twelve men, based on the same set of facts, differ widely, and can never be anticipated; and, whether wise or unwise, are clearly due to other influences than the commonly supposed conflict of facts and motives of truth and justice.

While it would be difficult to doubt the motive and intent of the average juror to be just and fair in his conclusions, it would seem that certain conditions and surroundings make it impossible in most cases to either understand the case in question or the principles of equity involved. The theoretical and ideal jury to whom are daily referred questions of life and death, and often momentous interests concerning families and individuals, is never seen in real life. The delusions of the court room, that the twelve men set apart for this duty are endowed with a large and sufficient mental capacity for the discernment of justice, is far from being true in reality.

From a medical and scientific point of view, the average twelve men who are appealed to by the counsel and judge to wisely determine the issue of a case are usually incompetent naturally, and are generally placed in the worst possible conditions and surroundings to even exercise average common sense in any disputed case.

In a noted trial at Hartford, Conn., out of a panel of one hundred jurors, twelve men were finally selected after a long, searching inquiry. Five of them were farmers, who worked hard every day in the open air, men who were unaccustomed to think or reason, except in a narrow way along their surroundings and line of work. These men all swore that they had not read any details of the case, although it occupied a large share of public attention and had been discussed freely in all the papers. They were muscle workers, with but little mental exercise, living on coarse, healthy food, and sleeping from early evening to early

morning. Of the rest of the jury, one was a blacksmith and two were mechanics, all steady workers; one was a horse trader, one a groceryman, one a retired farmer and trader, and the last man was an ex-railroad man who had no business. Every one of this jury was accustomed to be in the open air, and had not read details of the case, although he had heard it talked over. Not one of these men would have been chosen to take charge of any trust, or to decide on any matter outside of his everyday life—simply because, on general principles and from common-sense observation, he would have been considered clearly incompetent.

For ten days this jury was confined from five to six hours a day, listening to the testimony of the mental capacity and motives of the maker of a will that was disputed. Of course, they disagreed; and had they reached a unanimous verdict, its wisdom and justice would have been a matter of accident.

In a celebrated case tried in an interior town in New York, a most complicated chain of circumstantial evidence, involving the questions of concealed motives of unusual acts and conduct, of blood-stains, of the accuracy of chemical and microscopical work, of different opinions of competent men, was submitted to a jury of the following persons: one carpenter, one wagon-maker, three coopers, two farmers, one groceryman, one contractor, and three nurserymen. These men all testified that they had not formed an opinion on the case, although it had been town talk for months. Not one of them could naturally have given an intelligent opinion on any of the issues of the case, even if they had been presented in the most impartial, simple manner by the judge. When two opposite views were urged by opposing counsel, in an adroit partisan manner, the most uncertain mental confusion would be inevitable.

This particular jury was not only incompetent naturally and by want of training to discriminate facts that were unfamiliar, but its members were unaccustomed to consider any range of facts compared with others to determine which were true.

In a third celebrated case, a jury composed of four fishermen, two shipbuilders, two stonecutters, one clerk, two merchants, and two persons of no business, was asked to decide on the facts of one of the most mysterious cases of poisoning. A number of expert witnesses and shrewd lawyers extended this case two weeks, and gathered a mass of statements that only the most astute judge could have disentangled. These jurymen were not only bewildered, but were mentally palsied by the appeals of counsel.

The methods of selecting jurors are thus literally open doors for the defeat of the very purposes of justice. The ostensible purpose in the selection of a jury is to secure men of honesty,

intelligence, and courage to reach unbiased conclusions in accord with the facts. In reality the practice is to gather men who can be influenced by the counsel—men possessing some defect and weakness which can be taken advantage of by one side or the other. The issue of the case will depend on the influences which can be brought to bear on the jury. Usually, jurors are rejected when they swear that they have formed an opinion; but when they assert that such opinions are subject to change from evidence and are not fixed, they are accepted. The real qualifications would seem to be availability, credulity, ignorance, and possibility of personal influence by persuasion, flattery, and appeals to some personal bias that may be known. Each counsel is interested in selecting twelve men he can influence to his view of the case, or, in the court language, "men he can handle readily." It is unfortunately true that jury duty is evaded by the best men, and to a large extent the men who are willing to serve in this capacity are more or less incompetent. In the cities, idle men and professional jurors are always available. In country towns, farmers, mechanics, and others find the jury duty a recreation, and a not unpleasant change from the monotony of their life. While these men are superior to the city jurors in honesty, they are less able or accustomed to the confinement of rooms and the emotional appeals of partisans.

It is evident to any general observation that the average jury is unable to pass judgment on, or even to comprehend in any adequate way, many of the questions submitted to it—such as motives and capacity of the mind and the power of control; the analysis of conduct, and the conditions and influences which have been dominant in certain acts; the application of the law, and the distinctions of responsibility and accountability; the distinctions of science as to the meaning of certain facts, or the recognition and discrimination of facts from the mass of statements. To this incapacity are added the passionate appeals of opposing counsel, who draw the most opposite conclusions from the same set of facts. Then the judge charges that if they shall find such and such conditions to be true, they shall bring in such and such a verdict; and if such and such conditions are not true, another verdict must be given. This brings them into a state of the most bewildering mental confusion, from which only the trained judge could extricate himself. The wonder is that they are able to reach any verdict that even approximates the levels of human justice.

These facts are recognized by all observing men, and have been the subject of serious discussion for a long time. It has not occurred to any one to consider the conditions and surroundings of the jury who are to decide the great questions of life and death

so often submitted to them. Practically and literally the twelve men of uncertain intelligence, and doubtful capacity and training essential to determine the disputed questions, are placed in the most adverse hygienic conditions for healthy brain and functional activity. Supposing these men to have fair average intelligence with honesty of purpose, they are placed always in a close, badly ventilated court room, and are obliged to sit in one place for five or six hours a day; in cases of capital crime they are housed at some hotel at night, and have changed diet, changed sleeping rooms, imperfect exercise, continuous mental strain, and this may be continued for a week, ten days, or even longer. Intelligent and sound brain reasoning would be impossible under these conditions. Even judges, trained to examine and reason from facts along legal lines, display weakness and confusion of mind at the close of a long trial on many occasions.

The practical observation of any jury in some important trial will show after the first day a listless abstraction that slowly deepens into a veritable mental confusion. At times, some one of the jury will appear impressed, but soon he settles back into a prolonged, steady, vacant stare at the counsel and witness. As the case goes on the faces of the jurors become paler, or increase in redness; their eyes lose their intelligence and become vacant or watery. Some show restlessness in their frequent changing positions of body; others become somnolent and inclined to stolidity; others are constrained, and seem to be struggling to keep up some degree of dignity, and imitate the judge in severity of manner. When the counsel flatters them, they start up anew and assume the appearance of more dignity and wisdom. Every lawyer has many curious stories of the schemes and devices to capture juries and jurors. Many of these turn on the debility and confusion of mind which come from changed surroundings and functional disorders resulting from confinement and mental exhaustion.

After the second day all connected ideas of the case become confused; only here and there some fact impresses itself, or some witticism or story that is strange or grotesque, or some conflict of lawyers, or reprimand of the judges. All the rest is vague and uncertain. The surprise on the faces of the jury, as the judge and lawyers repeat the testimony of the witnesses, shows that it is new, and they did not hear it at the time it was given. The pleas of opposing counsel often create equal surprise in the faces of the jury. If the jury were to render a verdict after one side had closed, it would be for that side. The same conviction is noted at the close of the arguments of the opposite side. The judge's charge often dispels this conviction for the last speaker, and throws them back into more helpless, confused states. They are

told to decide between this and that statement, and if they think this is true, they must find so and so; if that is true, the verdict must be so and so. In reality they have no very clear conceptions of any of the facts the judge has called to their attention. They go to the jury room in a dazed mental state, or possessed with some particular idea that has become fastened in the mind; some idea that has no logical support or sequence in the testimony which has been offered.

The following study of a case that was recently tried indicates conditions that are present far more frequently than would be supposed:

The case was murder, in which an intricate chain of circumstantial evidence pointed to one of three men as guilty. The jury was composed of five farmers, four mechanics, and three merchants. Nine of them were active muscle workers, living in the open air most of the time, and three were actively engaged indoors. The trial lasted eleven days. The jury were boarded at a hotel, and had no exercise except walking to and from the hotel to the court room three times a day. Four of the jury complained of dull headache. On the fourth day, five of the jury had attacks of indigestion, with pain and nausea. One had chills on the night of the same day, and was given quinine freely. Two men had attacks of what was called rheumatism, consisting of pain and stiffness of the muscles, and a physician was called. Eight suffered from insomnia and constipation after the fifth night. All suffered from bad feeling and dizziness while in the court room in the afternoons. Four had coughs and colds, for which rock candy and rye whisky were freely used. Several experienced extreme drowsiness in the court room. The arguments of counsel and the judge's charge occupied a day and a half. After the verdict and the discharge of the jury, four of them were confined to bed for several days. Here were twelve men, suffering from functional disturbances due to bad air, changed surroundings, and auto-intoxications, called to decide the issues of life and death.

In a case of murder and incendiarism, where the verdict of the jury was criticised severely, the following were the facts: The jury was composed of farmers, miners, tradesmen, and mechanics. Four of them were sufferers from cough and influenza; six complained of loss of appetite and headache; one suffered from malaria, so called; and one from a return of an old rheumatic attack. The trial lasted eight days, and most of the time the jurymen were practically sick—made so by the surroundings and changed conditions of living. The diet of hotels, consisting of rich meats and desserts in great variety, is usually different from the average food of the average jurymen, particularly of the working

class. The result is always overeating and under-exercise. This alone would quickly break up or disorder the mental activities. In addition to this, the confinement in the bad air of court rooms brings new sources of poisoning, particularly deficient oxidation, which of itself is sufficient to derange the normal brain functions. The crowded rooms at hotels are either overheated and badly ventilated or cold and noisy. The time for retiring and rising varies, and the usual habits of the juryman are changed in every respect. His accustomed food, sleep, and exercise, and his manner of thinking and the subject of his thoughts, all are broken up. He is asked to follow an intricate chain of reasoning, and discriminate the errors, and told that this is true and that is true, and that the law should lead him to some other point. He is flattered, and his pride is roused to do the best he can. He grows more incapacitated daily as the evidence accumulates and his system becomes deranged. Then, in despair, he will suddenly form some conclusion, guided by a fancy for some attorney or some remark by the judge. Perhaps a stubborn member of the jury has formed a conviction on the first day of the trial, and all the rest of the time is passed unconscious of evidence, *pro* or *con*, and in the jury room his very stubbornness wins.

In a noted murder trial at Portland, Me., it was evident that the jury had been impressed favorably to the prisoner. The prosecuting attorney suggested to the sheriff that he invite the jury to church Sunday evening to hear a noted preacher. The topic of the clergyman was, "God's Hatred of Sin, and DIVINE JUDGMENT." The attorney knew the topic and the intense dogmatism of the preacher, and calculated its effect on the jury. A verdict of conviction followed, due almost entirely to the sermon.

The personal characteristics of the jury are often the only doors through which they can be influenced. Religious, political, and social or personal prejudices are often considered by counsel in the presentation of the evidence. In reality, the average juryman becomes more incapacitated to rise above his prejudices, or to reason impartially, every day he is confined to the court room. At the end of a long trial he is utterly unable to form any new views, and nothing remains but his old prejudices, and these are often more fixed than ever.

The following record of a juryman's experience was made by a carpenter of more than average intelligence. He put down each night his impressions: The first day he was impressed with the magnitude of the case and the sadness of the prisoner. He did not sleep the first night, for the reason that four men occupied one room. The air was bad, and two men snored loudly.

The second day he tried to remember all that the witnesses said, and its bearing on the case, and at night was very weary and went to bed early, but was wakened and disturbed by the other jurors. The third day his head ached, and he could with difficulty follow the testimony. His appetite was poor and he was drowsy. The fourth day he was astonished to hear opposing evidence; statements which had been made by apparently honest men were affirmed to be false. He was shocked, and his first impressions and personal interest were disturbed. His head ached, and he felt weak and nervous; his appetite and sleep were broken. The fifth day he gave up all efforts to follow the testimony, or to understand what was said. He felt stupid and excessively tired. The other jurors began to complain of the food and the sleeping rooms, and had several quarrels with each other on religious and political matters. Foolish stories were told, and card-playing and personal boasting filled up the evenings. They all manifested disgust at the trial, and longed for the end, and declared they would never be caught in a similar case. On the sixth day the case was closed. The arguments of attorneys and the judge's charge seemed very dull and wearisome. He felt sick, looked forward to a release, and his interest in the case had died out. He could not understand why so much was said that was contradictory, and why the judge should not tell them the real facts of the case. In the jury room no discussion took place: each one voted "guilty" or not "guilty"; and when they found the majority was "guilty," most of them followed the majority. Two of the minority became angry, and refused to vote for over a day, except in favor of the prisoner. They gave no reasons for their belief, only saying that they were right and the rest of the jury were wrong. Finally, one of these men was accused of having some personal object in voting for the prisoner, and after a short altercation he changed, and the other man followed him, and the verdict "guilty" was agreed upon.

In my experience as an expert witness I have frequently noted the change of feelings in a moderate-drinking juror. If the prisoner was an inebriate, and the crime associated with excessive use of alcohol, the first two days of the trial all moderate-drinking jurymen manifest strong feeling for the prisoner. Later, when they become tired, dull, and debilitated by the surroundings, all this feeling changes to severity and desire to punish, no matter what the evidence may be. All natural sentiments of sympathy and kindness are replaced by the coarser, lower motives, as the brain becomes disordered and weakened. If any of the jury have had a similar weakness or committed a similar crime, they usually urge most severe punishment, and especially after they lose their mental vigor in the bad air of the court room. In some

cases the opposite prevails, and jurors are strangely stubborn in their unreasoning convictions for the prisoner. This is naturally the outcome of placing untrained men in positions which they can not fill, and requiring of them clear judgment under circumstances where it is almost impossible to act normally.

WHY CHILDREN LIE.

By NATHAN OPPENHEIM, M. D.

IT is not many years ago that the occurrence of pulmonary tuberculosis in a person stamped the family of the sufferer as tainted. So lax was the common as well as the professional logic, and so imperfect were the observations drawn from experience, that the fact of inheritance clearly seen in some diseases was immediately applied to all cases where there was any ground for the analogy. What was true of one case must necessarily be true of all others that seemed similar; and the growing belief in heredity helped to make this opinion progressively stronger. Even to-day there still remains with thousands of people a belief in the "taint" of a family that has unfortunately had a tubercular disease in one of its members, and the general public is merely beginning to awaken to the distinction between an inherited disease and an inherited *predisposition* to that disease. As a matter of fact there exists between these two things the widest space; indeed, a predisposition may act as a warning, may insure a greater care and a better conformity to laws of right living, so that the threatened persons are often able to avoid dangers which formerly they might have dreaded as inevitable.

Tuberculosis is not by any means the only sickness which carries with it a widespread "taint." In the same way that an almost insuperable objection to a man or a woman contemplating marriage was a "consumptive strain in the blood," so an equally potent obstacle was relation to a lunatic. There are still other parallels between the two cases: one's brother who died of pulmonary consumption cast a cloud upon one's physical reputation; but if that same brother had suffered from a white swelling of the knee (tuberculosis of the joint), it carried but little significance with it. Likewise, mania cursed a whole family in all its ramifications; but marked eccentricity, kleptomania, or wrong conduct amounting to what we now call moral insanity would be entirely harmless, would be strictly confined to the person in whom it appeared.

This lack of knowledge and the consequent laxity in judgment have wide-reaching results. Outside of those immediately appar-

ent they influence so intimately our methods and standards of education and culture that they call for more attention than has yet been given them. It is particularly in regard to education and the environment of children that I make these remarks, because here the effects act most powerfully for good or bad. Every day I see children who exhibit these educational distortions, many of which seem to a certain extent superfluous. And nothing is more common than to find children, with an evidently rudimentary conception of truth, who willfully and often for no reason make exaggerated or false statements, who seem really to deceive themselves as well as others, who make their relatives miserable by threatened lack of responsibility, which, spreading out in many ways, points to an unhappy or disgraceful life.

This fear is so common that the majority of people, I fancy, have felt it more or less. It is so natural to regard truth as the foundation of our whole moral structure, to look upon it as the loveliest product of a fine character, that any deviation from it must necessarily be held as most unfortunate. I should be similarly impressed if I did not feel certain that the fear is often wrongly placed, that this habitual telling of falsehood has its origin, not in viciousness or a spontaneous desire to deceive, but rather in causes for which the person is not entirely responsible; which, on the contrary, are the natural results of natural causes.

The origin is to be sought among the fundamental workings of the mind; it begins with our first attempts at perception, our first uses of words. A word is always a more or less complex idea composed of more than one sort of image. According to our innate tendencies these will be predominant as visual or speech or writing or auditory images. They are elements which every one's judgment in expression must use, and the variations give each person his individuality. Most of us think in speech conceptions; we hear rather than see our thoughts. It is only occasional that we find a man who sees a mental image of a concept, who clothes his thoughts in written words. When we do, we have found an artist who sees and remembers thoughts as well as things as definite memory pictures. Again, there is a class who speak or write their thoughts internally, but the thought or the thing is always expressed in letters. This association of thought with writing movements is most often found in those of a decidedly literary tendency, whose concepts appear to their consciousness as printed lines. Of course, it goes without saying that no one is absolutely confined to any one method. It is merely the predominance which is sufficiently marked to give a trend of individuality.

All these methods are simply the internal process of speech, they are the body of our concepts. Likewise there must be an

external process, our method of expression—words. But it is not entirely essential that words should accompany the conceptions, and as a matter of fact we find in certain nervous conditions just exactly this state of affairs. And it is just at this point, as we shall very shortly see, that we may look for a frequent cause of the unnecessary, the unexplainable, the habitual lie.

The natural inference is that between the formation of a concept and the rightful expression of it there must be a direct and uninterrupted connection, with the least tendency to interference from cross-currents, with the fewest possible obstacles from exaggerated inhibitions. This condition finds a parallel to a certain extent in the phenomena of producing electric energy, its transmission in a current, and its final exhibition in some palpable way. Now, in order to insure this connection there must be perfect insulation, a perfect protection against opportunities for divergence, a guard and a help for the characteristic activity. In mental workings we have this insulation in memory, the principal property of nerve substance, the result of repeated and continued impressions. As concepts are conveyed through the senses, so the repeated recognition and use of them are provided for by the memory activity; and upon the normal and exact co-ordination of this activity do our mental workings depend. The relation and combination of remembered concepts must be absolutely regular, must coincide with the normal standard in order to give the person an image which will correspond with that of his fellows, which will appeal to them as really true.

But suppose, as most people affirm, that there is a particle of insanity in every one's make-up; let us for the time admit that there are variations from the normal in every man. We are then forced to say that, as the standard of the normal can not vary, it naturally follows that deficiencies are abnormities, are signs of degeneration, are signs which point to a lack of sanity. This does not mean that men so constituted are not fit to be trusted in the general affairs of life or to fill their places in the world. In the same way a man may be weak in the knees and still be capable of locomotion, even though he halt. Nevertheless, such a man is susceptible of mishaps and accidents brought on by natural inability; and, moreover, no one would be justified in punishing him for such accidents. In the same way no one would think of blaming a man because he was color-blind, any more than of punishing a woman because she happened to be unable to distinguish smells. By these analogies we merely conclude that we constantly find variations from the normal occurring spontaneously which nevertheless do not prevent the possessor from mingling with others on the ordinary footing of social and business intercourse. This principle has long been recognized among

lower animals, but there is a natural prejudice against applying similar rules to men.

Likewise is this true concerning man from his first growth. He is born with the *possibility* of various characteristics and individual peculiarities. Just exactly what these will be and how far they will develop depend to a considerable extent upon his environment. Of course, it goes without saying that heredity counts for much, although heredity is not everything. Most of all is it not supreme in view of the fact that our system of education and culture has the strongest tendency for leveling, for mediocrity. Our infant education, our school life, domestic life, social life, all tend to trim away whatever of originality—good or otherwise—the individual may possess. Our methods are mainly inhibitory: we are constantly talking about what one must *not* do. The decalogue itself, the declaration of our moral and religious code, is couched mostly in terms of negative command. Thou shalt *not* steal, thou shalt *not* lie, thou shalt *not* worship idols, it says; and this is far different, when reasoned about broadly, from *speak the truth, be honest, love God.*

Given, then, a tendency to variations from the normal, it follows that our principal care should be to ascertain what this normal is, and to conform to it. But, so far as common experience goes, this is the last thing to be carefully worked out. The tendencies to variation are emphasized by the frequent liability to inferior physical conditions. Some of these are so remote that they would be thought of only by the physician-psychologist, while others are of such common occurrence that every practitioner is familiar with them. Now, one of the most striking of these—unfortunately not frequently noticed except in its ultimate exaggerations—is that disturbance of conception produced locally in the cortex of the brain by which the person is unable to distinguish between the internal processes and their external causal conditions. If the ability to differentiate is impaired, an hallucination is present, dependent upon processes in those parts of the brain which preserve memory pictures of the most varied kinds. As the result of this condition we may have expressions and acts which are seemingly at utter variance with the actual premises from which they start. The familiar example of the different views which two knights looking upon opposite sides of a shield take, is an old and trite attempt at explanation of this condition. In many, many cases it is not merely that people in giving conflicting accounts of a fact see isolated and separate parts thereof; very frequently there is a wider basis: the condition—certainly pathological in its results—of broken connection between internal processes and their external causal conditions. Thus, a child may be reproved by a teacher: we should expect that nor-

mally there would be a continuity of concepts beginning with the commission of a breach of discipline, followed by correction from the teacher, and ending in improved conduct on the part of the scholar. But frequently this chain is broken. The child fails to recognize the connection between these component parts, or certain parts are obliterated and others exaggerated, or the impression is cross-currented or side-tracked, with the result that the final impression and account of the matter may be widely divergent from the original facts. The conclusion usually is that the child has been willfully lying. Again, the child may see two dogs playing together, and, being subject to abnormal mental processes, comes to his mother with a tale of a horrible struggle between ferocious bears, with imminent danger to himself. The startling element in the matter is that usually the parents either smile indulgently, remarking that the child has a vivid imagination, or on the other hand they will punish him for an attempt at causeless and vicious deceit.

However, I should consider this explanation problematical if it had no further basis than an obscure mental condition. But as soon as one looks carefully at the matter one is strongly impressed by the number of additional conditions which may act in similar ways. Indeed, the matter becomes so plain that we may say, broadly, that any cause which makes for intellectual tenuity has a tendency to bring about this state of things. Recently we have named this psychical trauma, a morbid nervous condition caused by repeated injurious impressions; and it is a fact that beyond distinct mental disorders codified as diseases some of the lower emotional and mental activities may in the same way be markedly injured. We have evidence of this from such signs as nervous digestive disorders, hysterical attacks, loss of sleep otherwise inexplicable, disturbances of flushing and pallor, all of which may be results of psychical effects repeated again and again. These symptoms should not be called diseases, or in any way primary disorders; they are merely natural results which flow from natural causes, just like the loss of self-control in fright or breathlessness from the shock of cold water. The continued repetition of them wears, as it were, a rut in the brain, so that any impulse approaching it slips out of its ordinary path in the direction at once of least resistance and utter distortion. Again, the very faulty methods of our teaching by rote, of mechanical repetition and memorizing, which seems to be the basis of our school system, must necessarily lean toward psychical poverty; and the more these vicious stimuli are repeated, the greater must be the effect toward an unfortunate end.

Still, there are other causes, of a purely physical nature, which doubtless will appeal more strongly to most readers. It is well

known that the products of fermentation and putrefaction found as a result of faulty assimilation of food may act as irritants, either in the way of repressing normal impulses or exaggerating feeble sensory impressions, to the end that the relation of concepts may be quite broken, and even go so far as to assume the dignity of full illusions. A full list and explanation of the possible causes of disturbances of the perceptive process would be beyond the scope of this article; although it is distinctly in place, I believe, to mention a few of the most common, simply to give an idea of the wide range which they occupy. Among them are diseases of the eye, such as phenomena which occur in the end distribution of the optic nerve, among which are light phenomena developed in the retina, the so-called light dust of the internal field of vision, and the shadowings and polychrome pictures. These are all aided by processes in the retinal vessels, such as those involving the blood-corpuscles; likewise the pulsations of the central artery, opacities of the cornea and vitreous, and indeed all conditions producing entoptic shadows on the retina may give rise to illusions. And these are not all; in addition we may include catarrhs of the middle ear, irritations of mucous membranes and the skin of the head and face, blows and falls upon the head, as well as morbid changes in the viscera and muscles.

The sum of the matter is this: We constantly see children who lie habitually, and usually for no recognized reason. This habit is commonly looked upon as an indication of spontaneous viciousness. In the majority of cases this opinion has no basis in fact. The children usually are suffering from disorders of mind or body, or both, which radically interfere with the transmission of conceptions and perceptions from the internal to the external processes of expression, so that they are really unable to be more exact than they seem; usually these peculiarities are either neglected or cause severe punishments to be inflicted, with the natural result that they are confirmed and added to by various unfavorable characteristics of cruelty, revenge, slyness, and *actual* deceit.

Lying does not necessarily mean viciousness, nor is truth to be regarded merely as a saving means of grace. On the contrary, many a child may be led to forget the lie simply by being placed in proper physical and mental environments.

THE result of an experiment instituted to determine the effect of rhythm on the visibility of a succession of optical signals, tried by M. Charles Henry at the Dépôt des Phares, France, is to show that it is possible to increase the range through which an optical signal will carry by adjusting the succession of flashes according to a sufficiently complex nonrhythmical law.

MORBID HEREDITY.

By M. CH. FÉRÉ.

THE study of morbid heredity is full of interest, because the knowledge of its laws may assist us in finding preventive measures against it, and because it may thereby be a means of comforting persons who are under those laws. In seeking a definition of morbid heredity, we first take Sanson's definition of biological heredity as the transmission from ascendants to descendants, by sexual generation, of natural or acquired properties. With acquired properties we may include morbid ones. Heredity of morbid properties seems to obey the same law as heredity of natural properties, for which we may accept Darwin's formulas of—1. The law of direct and immediate heredity, under which parents tend to transmit their physical and moral characteristics to their descendants. 2. The law of predominance of direct heredity, under which the character of one of the two progenitors is predominant in the product. 3. The law of heredity in reversion, racial heredity, which is applicable to the often-observed facts of atavism, or the reappearance in descendants of the characteristics of a more or less remote ancestor; and 4. The law of homochronous heredity, or the reappearance of hereditary characteristics at the same periods of life in ascendants and descendants.

Morbid heredity does not inevitably obey the laws of direct heredity. It is a well-known fact that diseases in morbid families are not usually transmitted with a perfect likeness. The homologous or similar heredity, which is observed chiefly as to mental diseases, is rare as to other diseases. Usually the disease is modified in descent. A diabetic patient produces an ataxic son, or a hysterical daughter, or an epileptic child. John Hunter seems to have anticipated these variations when he maintained the existence not of hereditary diseases proper, but of a hereditary dispo sition to contract them—a hypothesis which, though somewhat vague, may account for dissimilar heredity and also for the frequent happy absence of heredity. The probability of morbid heredity manifesting itself is increased when both the parents are attainted with the same defect. Consanguineous marriages, which have been charged with being an important factor in the genesis of neuropathy, of deaf-mutism, and of degeneration in general, really are of effect only through the accumulation of heredity. Consanguinity favors the heredity both of good and of bad family qualities. In healthy families it is desirable; in morbid families it should be shunned.

Pathological selection of nervous parties, who seem to be attracted to one another by invincible sympathies, involves the

same probabilities of degeneration as morbid consanguinity. It appears with nervous, hysterical, and veneric persons, and with criminals, among whom vice becomes the basis of unions leading to progressive degeneracy.

Some infectious diseases, usually propagated by contagion, may be transmitted to the child by the mother, or even by the father, while the mother remains free from them. The disease being due to a special agent of infection, that is, to a being with an existence of its own, such transmission can not, properly speaking, be regarded as a fact of heredity. The generative agents have served only as vehicles for the morbid agent or its products. What has been transmitted is not a natural characteristic, or even a definitely acquired characteristic, but a strange and accidentally imposed property, susceptible of disappearing or of being destroyed. Transmission of this kind does not correspond with the definition of biological heredity. Direct heredity of certain diseases has attracted the attention of observers of all times, and has been most regularly noticed in mental diseases.

The family defect is very often exhibited gradually. One or more generations manifest slight troubles, which we might call preparatory. Heredity has to be accumulated, capitalized, as it were, before displaying itself as a morbid entity to which we can give a name. We often find individuals among the ancestors of insane persons, individuals subject to overexcitement, enthusiasts, originals, unfortunate inventors, dissipated persons, or men of irregular life or afflicted with mental or moral eccentricities.

Heredity is not manifested in the same degree in all the forms of madness, and is less evident in the acute than in the chronic forms. Mental troubles generally are most likely to transmit themselves by heredity when they are active at the moment of conception. They are less surely transmissible if their activity in the progenitors is suspended at the time, and especially if the first attack does not come on till after the birth of the child. The fact that we occasionally see a person who has not yet been insane transmit the predisposition to become so to his descendants demonstrates that it is not the disease itself, but the aptitude to acquire it that is transmitted. Accumulated heredity often results in the production of individuals distinguished by physical malformations or by abnormal emotionalisms, constituting what are called the physical and the psychical stigmata of degeneracy. Yet we can not say that heredity impresses special characteristics on madness. But persons inheriting morbid tendencies are more sensitive to excitement of every kind, and more frequently suffer acute irritations under the influence of insignificant causes, while most usually these irritations disappear as easily and as abruptly as they came on.

It is now impossible to deny the heredity of mental troubles, as well of those in the case of which we do not know the accompanying anatomical lesions as of those with which we think we are better acquainted, as in general paralysis and senile dementia. Still less doubtful is it that our cases are most frequently not of direct and identical heredity, but usually of what we call collateral and dissimilar heredity. The son may not inherit from his father, and if the nephew inherits, he will generally seem to be afflicted with a different mental affection from that of his uncle. It must, therefore, be understood that what is meant by heredity in mental diseases does not necessarily correspond with the definition of normal biological heredity.

This frequent dissimilarity in the inheritance of madness becomes more clearly defined when we regard the alliances of the psychopathic family. Nervous troubles very different in their manifestations are frequently met with in families of insane. Prichard has given the name of moral insanity to a mental trouble which prompts to abnormal or mischievous acts while consciousness of their moral nature is wanting. This kind of insanity differs from the impulsive insanity, in which the patient is urged to violent, harmful, or criminal acts by a force which, though invincible, leaves him able to appreciate more or less sanely the character of those acts.

Vice and crime are, furthermore, often hereditary, like insanity. More frequently they are met in families combined with the most various mental disorders—insanity, imbecility, idiocy, etc. The combination of insanity and crime is observed not only in the same family, but often, too, in the same person. Physicians of penitentiaries have long insisted on the frequency of mental disorders among the convicts, and have become convinced that the causes of what is called prison-madness are inherent in the prisoners and not in the prison. It has, moreover, been remarked that debauchery and instinctive perversions are often met with in the hereditary antecedents of insane persons.

Not criminality only has family connections with insanity, but the artistic temperament and genius are frequently associated with it. An old writer has said that there never was a great genius who had not some tinge of insanity. Numerous men, illustrious under different titles, have been attacked with various mental troubles, or have belonged to families in which such troubles were common. The frequency of such associations suggested to Moreau de Tours his saying that genius is a nervous disorder. Further, while great men are rarely exempt from a trace of folly, madmen have no less frequently had a share of genius. Thus we sometimes find in the asylums calculators and musicians of remarkable aptitude in their respective lines. M. H. Nordau (De-

generation, 1893) has endeavored to demonstrate the constancy of these associations in a special category of artists and literary men whose imagination seems to rejoice in its departure from common ideas. He is liable to criticism for not having comprehended that the madness of these supposed degenerates consisted simply in seeking to surprise or scandalize, and that at bottom their thoughts were not much different from those of their contemporaries. While this criticism may be just as to M. Nordau, it can not clear the authors concerned from the suspicion of insanity.

Civilization favors the production of exceptional beings, men of genius as well as those most degraded by vice or by mental perturbations. The most civilized nations are as much distinguished by the number of their insane and criminals as by that of their men of talent. Civilization produces variation or excites the tendency to it, and it is manifested chiefly in the masculine sex. The parallel development of insanity, genius, and crime constitutes one of the most interesting illustrations of the tendency to variation which characterizes the evolution of mankind, and which results in a progressive inequality, against which the restrictive laws of individualism are of no avail.

Psychical disorders are often associated in families and individuals with other diseases of the nervous system, either growing out of lesions or not connected with known lesions—nervous affections. The relative frequency or nervous manifestations, whether isolated or associated with nervous or other diseases which we shall consider, is so predominant that all such family morbid manifestations may be designated under the name of neuropathic family.

Nervous diseases may be hereditary, and pass directly from father to son; examples of such are locomotor ataxy, epilepsy, and hysteria; but indirect and dissimilar heredity, as in psychopathies, is more usually observed. Family connections between diseases from lesions of the nervous system and nervous affections are proved by frequent coincidences among relatives, and also by their manifestations in the same person, either at the same time or in different periods of his life. Not rarely, further, are mental and neuropathic troubles met with in the history of the same person; and, moreover, a number of diseases are marked by both classes of symptoms.

The already somewhat chaotic picture of morbid heredity would still be incomplete if we omitted to add that among the members of a nervous family we often meet individuals affected with disorders of nutrition—gout, chronic rheumatism, diabetes—quite often hereditary diseases which, as much by their course as by their relationship, deserve the name of nutritional nervous affections. It should be observed further that other diseases, para-

sitic or suspected to be so, like tuberculosis and cancer, appear more frequently in the same families. The last coincidence may be explained by the fact that the system of nerves regulating nutrition may, when its activity is weak, diminish the resistance of the organism and favor the action of morbid agents.

The question of morbid heredity is still more complicated by the established facts that in a large number of tainted families there exist individuals wholly exempt, while the exceptional character of their cases can not be interpreted by the uncertainties of paternity; and that a considerable number of affections usually regarded as hereditary or peculiar to the family may appear in a family independently of all heredity. Many diseases are known that merit the title of family disorders and attack several children of a single generation without its being possible to find anything like them in either the paternal or the maternal line. The persistence of healthy individuals in an unhealthy family may be explained by atavism; but the appearance of a family disease without any resemblance among the ascendants constitutes an exception to the laws of normal heredity.

We are justified in charging certain toxic or infectious agents with being capable of determining, by the influence they exercise upon progenitors, the same morbid predispositions as heredity. Thus, we can attribute to chronic alcoholism, to saturnism, to morphinism, and to other habits of intoxication of parents a considerable number of nervous affections and psychopathies which are developed in the children at different ages, and confer upon them characters quite different from the characters of their parents. Acute transitory intoxications may have the same effect; and drunkenness of parents at the moment of conception or during gestation has been charged with producing imbecility, idiocy, epilepsy, and other diseases in the children.

The effect of intoxication by drugs may likewise be induced by emotional intoxication. The acute or chronic emotions of the mother during gestation may undoubtedly have a noxious influence upon the child and determine troubles of development in it, which may be manifested by anomalies of forms or by functional troubles revealing anomalies of structure. Bad food or defective hygiene, acting directly upon the nutrition of the mother, may have the same effects. All these conditions, finally, may be accumulated under certain circumstances.

In short, the predisposition to disease may be hereditary or congenital. Hereditary transmission is, however, not inevitable, and most frequently it is due to very diverse conditions in the nutrition of the progenitors. Some authors have associated the idea of degeneration with that of heredity, and designate a whole category of disorders under the name of hereditary degenerations;

but many persons who exhibit the characteristics of this category have not inherited them. The necessity of this connection between degeneration and heredity ought to disappear along with the notion of inevitable heredity. We may degenerate without a hereditary tendency thereto, and we may escape morbid heredity. Diseases which are developed simply on account of a hereditary or congenital disposition constitute manifestations of a tendency to degeneration. Morel showed long ago that a race of insane, whatever its origin, tends to exhaust itself in the fourth generation. The fact is found to apply to other hereditary diseases. The tendency to become sterile is, like dissimilarity, an indication of the diminishing vitality which constitutes degeneration, and may be found in plant as well as in animal species. Mr. Dixon has shown, as Morel demonstrated for pathological families, that mulatto stocks die out unless they are crossed with negroes or with whites, and the fourth generation usually marks the limit of their continuance. We have, therefore, a right to infer that it is by degeneration that various diseases which rarely arise except in consequence of a morbid predisposition are met with in the same families.

Congenital malformations act also frequently like the diseases with which they are found associated. Teratological heredity includes facts very like those which have been marked in pathological heredity. While we observe such malformations as sexdigitism, syndactyly, and ectrodactyly transmitted directly for several generations, we more usually see different deformities in the same family. This is because the malformation may vary in form and seat according to the age of the embryo in which a disorder of nutrition is produced. It has even been assumed that variation of species may have had a teratological origin; but we are acquainted with very few deformities that have been definitely established. If the tailless cats of Japan and the Isle of Man are of teratological origin, they constitute a unique exception. While we often observe various deformities in the same family, it is not more rare to meet a number of anomalies in the same person—a phenomenon which deserves special attention.

Most of the deformities compatible with life may be coincident with affections of the nervous system; and the patients whose nervous systems are most gravely affected are just those who present multiple deformities; idiots and imbeciles nearly always exhibit congenital anomalies, which likewise frequently occur in deaf-mutes, epileptics, etc. The anomalies found in the insane are less gross, but appear more frequently in proportion as the morphology of that class of patients is more carefully studied. The study of physical anomalies in neuropaths, though they are not less common, is still more frequently neglected. With epileptics who

have been attacked at an advanced age, and who had consequently resisted a large number of provocative agencies, fewer anomalies are found than among those who were attacked in infancy or youth. If the former held out against a larger number of occasional causes, it was because they were less predisposed, as they were less abnormal.

Teratological abnormities resemble neuropathies not only in their origin and the characteristics of their hereditability, but there can be found in their genesis, besides heredity, all the defective conditions of generation and gestation that have been charged, and justly, with the faculty of giving rise to disorders of the nervous system—emotions, shocks, defective food, alcoholism or any other intoxication, infections, etc. The greater frequency has been noticed of deformities among natural children in cases of conception during intoxication, disproportion in the age of progenitors, etc.

As the masculine sex appears to present a more marked tendency to variation in respect to development and in mental disorders, so it seems to do likewise as regards morphology. Mr. Francis Warner, who has recently examined fifty thousand children in English schools, found 8·27 per cent of physical anomalies among the boys and only 6·78 per cent among the girls. Functional anomalies were also more frequent among the boys.

Like monstrosity, morbid predisposition is the result of a disturbed evolution. In the same way as in families anomalies in form may manifest themselves in very diverse localizations, so anomalies in structure may be variously seated. It is thus comprehensible how, under the influence of the different conditions that usually provoke the manifestations of hereditary diseases—puberty, menopause, fatigue, physical or moral shocks, intoxications, or infections—we observe diverse affections appearing in the same family, but most usually bearing upon the same system. It is worthy of remark that most of these provocative conditions act simply by virtue of the exhaustion that results from them. Growth is usually included among the conditions favorable to the development of disease; but in reality periods of growth, when the processes of nutrition are most energetic, can be and are nothing but periods of resistance; and the susceptibility to attack is developed in the times following periods of growth, particularly of active growth.

The disturbances in evolution of the nervous system are most important in the consideration of the origin of diseases because that system is dominant in the phenomena of the life of nutrition, as well as in those of the life of relation. These disturbances may account for the numerous varieties of morbid manifestations in pathological families.

The want of resemblance in descent observed in pathological and teratological families evidences the want of embryogenic energy which is so accentuated in those families as to end in sterility after a few generations. The attenuation of embryogenic force which may be signalized by failures of very different elements may serve to interpret what is called dissimilar morbid heredity and that paradoxical heredity designated as collateral morbid heredity.

It should be remarked that dissimilarity in morbid families is not absolutely fortuitous. The head of a family gives rise to offspring suffering from different and differently seated disorders of evolution, that cause various morbid predispositions, the variety of which is, however, not so great but that we can find analogies in the manifestation capable of giving a family resemblance to them. Degeneration, in fact, does not take effect except under a kind of rule. As Morel has well observed, unlike degenerates of one family resemble unlike degenerates of another family to such an extent that, like monsters, they are susceptible, wheresoever they may come from, of a scientific classification. Degeneration has its laws the same as normal evolution; whatever may be its cause, it is manifested under a relatively restricted number of common forms.

The theory of the teratological origin of manifestations of morbid heredity is really the only one that will allow us to explain how very diverse conditions of generation, such as extreme youth or too advanced age of progenitors, disproportion in their ages, permanent or even transitory disorders in their vitality, drunkenness, intoxications, infections, accidental exhaustion of the nervous system, or acquired neurasthenia, can produce the same effects as morbid heredity. We should not, in fact, be surprised at finding that degenerates by heredity are not different from degenerates in consequence of disorders of nutrition in progenitors, since degeneration in general results from embryogenical troubles which are reduced, as a whole, to troubles of nutrition. The teratological theory of morbid heredity and of degeneration permits us to comprehend not only unlikeness in morbid heredity, but also the absence of heredity in diseases of the group presumed to be hereditary, but which might be more correctly called degenerative.

Greater importance attaches to disorders of development, when we regard their consequences, as they are produced at a period nearer the beginning of the evolution. External forms are fixed long before the structure of the organs has reached perfection. Thus in man birth finds some parts of the nervous system—and the most important ones, when the light of relation is regarded—in full development. It is therefore easily compre-

hensible that evolutionary disorders of the nervous system due to morbid heredity or provoked by influences of the medium may exist without external morbid aberrations. Furthermore, many lesions of the centers met with in neuropathic families in which no external deformities have been found have been attributed to evolutionary troubles of the nervous system.

A race is formed by the fixing of the specific characteristics transmissible by sexual generation. The families and the individuals composing the race transmit to their descendants characteristics of the family and individual characteristics combining themselves in infinite variety to constitute personalities which are yet capable of differing only in limited measure. When the specific qualities that characterize the race cease to be transmitted by heredity; when the children in a family cease to resemble their parents and their brothers and sisters without recovering an ancestral type, and there results a defective change in the adaptation to the physical and social medium, we say that the race is degenerating. By degeneration should be understood the loss of the hereditary qualities that have determined and fixed the characteristics of the race. The characteristic of what is called in human races morbid heredity, which is simply a degeneration, is an abnormal tendency to variation in the posterity, which becomes, in consequence of physical, mental, and moral faults, progressively capable of adapting itself. In the artificial races of domestic animals the result of degeneration is often reversion to a primitive type of the species with capacity to recover the old adaptations. The designation race has in this case been really given to variety, the hereditary qualities of which had not the fixity that characterizes a race. No reversions are observed in the natural races. In the human races in particular degeneration is not manifested, whatever some authors may have said about it, by returns to ancestral forms, but rather by evolutionary disorders bringing on somatic deformities and functional perversions incompatible both with the adaptations now necessary and with ancestral adaptations. Harelip, spina bifida, malconformations of the genital organs, so frequent in degenerates, have nothing to do with ancestral types; and sterility, which is the inevitable outcome of degeneration, can have but little relation to atavism. Considering the matter more closely, we find that the vices in the conformation of degeneration, which we call the stigmata of degeneration, are teratological deformities. If the degenerate fails to give origin to beings that resemble him, it is not because he has acquired the special faculty of transmitting characteristics that do not belong to him, but because degeneration is the dissolution of heredity.

The similarity which we find in the human species among de-

generates of different origin—a similarity that permits us to make a classification the scale of which is as a whole narrow enough, has been reproduced in experiments having the provocation of artificial monsters as their object. If the incubation of hen's eggs is disturbed by eccentricities of temperature, if they are warmed too much or not enough, if they are deprived of air, if poisonous substances or substances capable of modifying the nutrition of the embryo—ether, chloroform, alcohol, essences, or nicotine—are introduced into the medium in which they respire, if the same substances are caused to penetrate into the albumen, if they are shaken by abrupt shocks or feeble but repeated blows, monstrosities are generally produced; but it does not appear that any of these causes will provoke exclusively the formation of a special monstrosity. Each of these causes will produce a variety of deformities, any of which may resemble other deformities produced by other causes. In short, the general facts already noticed in degenerating descent may be found in hatches experimentally disturbed—unlikeness in the same families and resemblance of unlike types of one family with those of another.

Besides resulting in ultimate sterility, morbid heredity and degeneration contribute to the destruction of families and races by producing mental and moral differences among them that lead to dissensions and conflicts as mischievous as diseases. When multiple crossings of normal individuals have been effected in a single locality or country, they create in the end both physical resemblances—a family air, a national type—and also psychical likenesses, which entrain a community of tastes and consequently of moral ideas susceptible of becoming fixed for a long series of generations and of constituting a family or national character. The dissolution of heredity, which may be realized either by the introduction of strangers of too different races, or under the influence of native causes of degeneration, is marked both by physical unlikenesses and by the psychical and moral ones that necessarily accompany them. The social discords that spring up among a people like those that so often divide the families of degenerates, taken together, constitute a manifestation of the dissolution of heredity; their source is in a biological fact.

The facts that authorize us to regard morbid heredity or degeneration in general as the consequence of disorders of nutrition during the developmental period of evolution permit us to comprehend the exceptions to the laws of heredity, and consequently to conceive the possibility of securing means of favoring these exceptions and of contending against degeneration.

A strong temptation arises to propose a law prohibiting the marriage of certain categories of degenerates, whereby the natural

process of their extinction might be initiated by an artificial sterility. Such a measure would be impracticable, because it would be impossible to fix a limit; and it would certainly be inefficacious in proportion as the temperaments of the persons concerned should be averse to their submission to the laws. The contest may be made by less uncertain processes.

Restoration of a degenerated race—return to mediocrity, as it has been called—may be effected through crossing with individuals of healthy races. M. Sanson has shown, by good examples drawn from zoötechny, that heredity of biological characteristics, and even perhaps of the sex, is generally influenced by the condition of nutrition of the progenitors. The stronger of them attracts the resemblance to his side. It may be assumed that in a union including a morbid factor the healthy factor is in the better position to prevail, and all the more so because it has the atavistic tendency of the other side in its favor. But whether because of the rarity in our time of absolutely healthy elements, or for some other reason, we usually find that, in crossing, the good are more likely to lose than the bad to improve.

There are still other means than happy crossing that may help in the return to mediocrity. Less and less deficient children may be observed to be born in a family of degenerates as the biological conditions of the parents improve. There is nothing surprising in the fact that disorders of nutrition have an injurious influence; all improvements of nutrition may, on the other hand, be accompanied by a correlative amelioration of the products. Generation is, as a whole, the resultant of an excess of nutrition; the lower organisms, absorbing in the medium in which they live more elements than they need for the repair of their losses, increase in volume. When this increase exceeds a certain limit, the individual breaks itself up to form new beings. The process is much more complex in the higher animals, but it is fundamentally the same; and Haeckel has felt free to call reproduction the excrescence of the individual. The best conditions for generation are the best conditions of nutrition. To the regularity of their nutrition is due the regularity of the folding of blastodermic leaflets and the regularity of their further evolution. The arrest of development of a single cell in the earlier periods of evolution is susceptible of determining grave deformations.

Facts observed in human families, in which we see degenerates producing offspring less and less deficient as their own conditions of nutrition improve, indicate that under the influence of a superactivity of nutrition defective organisms might furnish a normal epigenesis. Further, the possibility of combating during the embryonary period the degenerative tendency which is

manifested by the delay of development and the frequency of morphological anomalies may be established on the basis of experimental facts which are significant although not very numerous. We find that in the artificial incubation of eggs certain conditions capable of accelerating the normal development are also susceptible of resisting the retarding and deforming influence of disturbing agencies that came into play previous to incubation.

Darwin has remarked that the reproductive function is the most delicate of all, and is also considerably influenced by the medium; in spite of a superabundant alimentation, a large number of wild animals become sterile or produce aborted or deformed offspring by reason simply of being kept in captivity; domestic animals, on the other hand, become more fruitful under the influence of a better *régime*.

If the influences of the medium are reduced simply to modifications of nutrition; if, on the other side, the embryogenic processes are of the same nature as the processes of nutrition in general, we may assume that the influences of the medium which are capable of happily modifying the nutrition of a defective organism are likewise capable of putting it in better conditions to contribute to the development of the embryo.

Finally, observation and experiment indicate that in order to contend with success against morbid heredity and degeneration, which are besides not inevitable, none of the conditions of nutrition, none of the influences of the medium capable of acting on the development should be neglected.—*Translated for The Popular Science Monthly from the Revue des Deux Mondes.*

ONE day, relates Mr. Murray, the publisher, in Good Words, Mr. Darwin came to the late Mr. Murray with a manuscript. As he laid it upon the table he said: "Mr. Murray, here is a book that has cost me many years of hard labor; the preparation of it has afforded me the greatest interest, but I can hardly hope that it will prove of any interest to the general public. Will you bring it out for me, as you have my other books?" It was the work on Earthworms, which had a large and rapid sale. The incident illustrates the modesty of the man.

A SUCCESSFUL experiment in telegraphing by induction without connecting wires has been performed by Mr. W. H. Preece between Oban and Auchnacraig, Scotland, while the submarine cable was broken. A gutta-percha wire a mile and a half long was laid along the ground from Morven, while on the island of Mull use was made of the ordinary overhead wire connecting Craignure with Aros. The distance between the two parallel wires was about three miles and a half. Using a vibrator as transmitter, and a telephone as receiver, the usual messages were successfully dealt with till the cable was repaired.

SKETCH OF WILLIAM CRANCH BOND.

IN seconding the obituary resolutions of the American Academy of Arts and Sciences on the first director of the Harvard College Observatory, ex-President Quincy used these words: "It is not too much to say that the extent of his knowledge, the winning urbanity of his manners, and his exemplary exactness in life and as an observer, in a great degree effected the attainment of those large means and increased powers which ultimately raised to its present prosperous state the observatory over which through subsequent life he watched, and which he left at death honored and improved by his labors and genius." Let us briefly trace the career which could deserve such a testimonial.

WILLIAM CRANCH BOND was born in Portland, Me., September 9, 1789, being the youngest son in a family of several children. His parents, Hannah (Cranch) and William Bond, were natives of England and were married there. The Bond family can be traced to the time of William the Conqueror, by whom Brandon Manor is said to have been granted to the contemporary ancestor of that line. William Bond was born in Plymouth, and became a clockmaker and silversmith. Having been induced to emigrate to America, he located at Portland, then called Falmouth, and engaged in cutting ship timber which he sent to England. In a short time he brought over his family, but the timber business not proving successful, he removed to Boston in 1793 and took up again his former occupation. His shop stood on one of the corners of Milk and Marlboro (now Washington) Streets, the other being occupied by the Old South Church. William C. Bond was then a Boston boy from the age of four years. He had little opportunity to attend school, for the circumstances of the family, as he afterward told Josiah Quincy, "obliged me to become an apprentice to my father before I had learned the multiplication table." But, judging from his later achievements, young William must have been the kind of boy that picks up knowledge, so his lack of set schooling was not so great a misfortune as it might seem.

His eldest sister described him as having been, at the age of fourteen, "a slender boy with soft gray eyes and silky brown hair, quick to observe, yet shrinking from notice, and sensitive to excess." She adds, in reference to his early developed tastes: "The first that I remember was his intense anxiety about the expected total eclipse of the sun of June 16, 1806. He had then no instrument of his own, but watched the event from a house top on Summer Street through a telescope belonging to Mr. Francis Gray, to which somehow he got access. In so doing he injured his eyes, and for a long time was troubled in his vision."

An elder brother writes of him at this early period, "He was the mildest and best tempered boy I ever knew, and his remarkable mechanical genius showed itself very early." He adds that in devising and making bits of apparatus that boys use in their sports, William was chief among his comrades. Before he was fifteen years old he had constructed at odd times a reliable shop chronometer. He had no model to go by, but made it after a description of an instrument used by La Pérouse, the navigator, which he had found in an old French book. Not having a suitable spring to put into it, he contrived to run it by weights. About a year later he made a good working quadrant out of ebony and boxwood, the best materials he had. His son, George Phillips Bond, has thus described this instrument: "It is no rude affair, but every part, especially the graduation, the most difficult of all, shows the neatness, patience, and accuracy of a practiced artist. A better witness to the progress he had already made in astronomy could not be desired. It is all that the materials would admit of, and proves that he must have been, even then, irrevocably devoted to astronomy."

About the time he became of age his father took him into partnership, and the clock-making business was expanded to include the rating, repairing, and making of chronometers. The first seagoing chronometer made in America was made by him in 1812. It at once went into service, and satisfactorily stood the test of a voyage to and from the East Indies. In 1810 the Bonds removed their business to Congress Street, and the family took up its abode in Dorchester.

Mr. Bond regarded his watching of the eclipse when he was seventeen years of age as the event that determined his pursuit of astronomy. Certain it is that he never after then abandoned it. Five years later he first came under the notice of older astronomers, and in this way: Prof. John Farrar, of Harvard College, having caught sight of a comet on September 4, 1811, watched its subsequent progress and published a paper on it in the memoirs of the American Academy. Dr. Nathaniel Bowditch, of Salem, to whom he communicated this discovery, did the same, and the comet was watched also by others. Before presenting his paper to the academy, Prof. Farrar learned that young Bond had seen the comet in the preceding April. He mentioned this fact in the account of his own observations and added the following notes, with which, he says, Mr. Bond had "obligingly favored" him:*

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* Much of the material here employed is derived from a historical sketch of the Harvard College Observatory, prepared by Mr. Daniel W. Baker, which first appeared as a series of newspaper articles, and was afterward reprinted in pamphlet form as one of the official publications of the observatory.

"I remarked on the 21st of April a faint, whitish light near the constellation Canis Major projecting a tail about one degree in length, and set down its place as follows: right ascension, 106°; declination, 7° or 8° south. Its motion and the situation of its tail convinced me that it was a comet. I noticed it several times in May, and supposed that its motion was toward the western part of the constellation Leo."

These observations on the comet brought the young chronometer-maker the acquaintance of scientific men and facilities for his favorite pursuit. Up to this time his observations had been made with the rudest appliances. The elder brother already quoted says of these early days: "I suppose it would cause the astronomer royal to laugh could he see the first transit instrument used by us at Dorchester—a strip of brass nailed to the east end of the house, with a hole in it to see a fixed star and note its transit; this in 1813. When we moved into the Hawes house, he procured a good granite block; we dug a deep hole and placed it at the west end of the house, and got Mr. Alger to cast a stand for the transit instrument, a small one, which I think belonged to Harvard College. From this time he began to live among the stars."

Bond's sister also gives an account of the setting up of the first telescope used by him at Dorchester, and says that through it could be seen the satellites of Jupiter and the rings of Saturn. She adds that in the pursuit of astronomy "he had had no assistance whatever, except from the genial kindness of Hon. Josiah Quincy, who had early recognized the future astronomer in the unpretending boy in the watchmaker's shop on Congress Street, and whose kindness and encouragement never failed throughout the subsequent years."

The obstacles in the path of the young astronomer were now rapidly removed. The leading men of science in Boston and vicinity gave him their aid and counsel. "He has mentioned," writes his son, "the names of Dr. Nathaniel Bowditch, Prof. Farrar, and Tutor Clapp as those from whom he received most encouragement to continue the cultivation of astronomy. Upon his friendly intercourse with the eminent mathematician and astronomer first named he often dwelt with peculiar pleasure and warmth of feeling."

Although instruction in astronomy had been given and astronomical observations had been made by the professor of natural philosophy at Harvard for a century or more, the college had not as yet been able to erect an observatory. In 1805 John Lowell, uncle of the founder of the Lowell Institute, had obtained from Delambre in Paris advice as to a building and its equipment. But nothing further was done at that time. Ten years later the

college authorities took up the subject anew and appointed a committee to form a plan for an observatory. Mr. Bond was then about to make a trip to England, and his friends Farrar and Bowditch procured for him a commission as agent of the college to obtain information as to the construction and instrumental equipment of the observatory at Greenwich, and to make such drawings as would be needed in constructing an observatory for the college. He was requested also to obtain from the makers the prices of instruments like the principal ones used at Greenwich. "He performed the service," says the writer of the sketch above referred to, "and reported in detail in the following year. That nothing practical came of it for a quarter of a century was not owing to the will but, comparatively speaking, to the poverty of the college.

"This result followed, however, that, upon his return, Mr. Bond constructed the model of an astronomical dome, the operative plan of which was the same as that of the great dome built in 1844, and which has been in satisfactory use at Cambridge to the present time. The chief peculiarity of its mechanism is in the method of rotation by means of smoothly turned spheres of iron. The dome rests on these at equidistant points, and, being set in motion by suitable gearing, the iron balls sustaining its weight roll along a level, circular track of iron, the circumference of which is equal to that of the dome. The method was unlike that previously in use. It appears to have been original with Mr. Bond, as is perhaps evinced by a remark in his report for 1848 referring to the matter: 'If carefully examined, it will be found that this arrangement is as perfect in theory as it is appropriate and convenient in practice.' Experience has shown that spheres of hard bronze are more serviceable than those of iron, and bronze is now used."

While Mr. Bond was abroad, he married, July 18, 1819, his cousin, Selina Cranch, of Kingsbridge, in Devonshire. Returning home, he went to live in Dorchester near his father's residence in a house which he bought. On these premises he erected, about 1823, a small wooden building which he carefully equipped for astronomical observations. This building is meant in the official reference to the "observatory at Dorchester" found in various publications. Its position, as given by Mr. Bond in 1833, was 0° 3′ 15″ east of Harvard Hall in Cambridge.

Mr. Bond now advanced rapidly in his favorite pursuit. "As soon as his circumstances permitted," writes his son, "he imported more perfect apparatus from Europe, and continued to add to his collection until it was the best in the country." In his little observatory "no eclipse or occultation escaped him, though occupied in business during the day in Boston." After gathering

for several years materials for investigating the comparative rates of chronometers at sea and on shore, he presented a paper to the American Academy in which he effectually disposed of the scientific question involved, so far as it related to the interests of navigation. Mr. G. P. Bond, who records this, states that his father investigated also the influence of changes of temperature in the presence of large surfaces of iron upon the performance of chronometers, and, "although the conclusions arrived at were at variance with the opinions of men high in authority in such matters, they are now known to be correct."

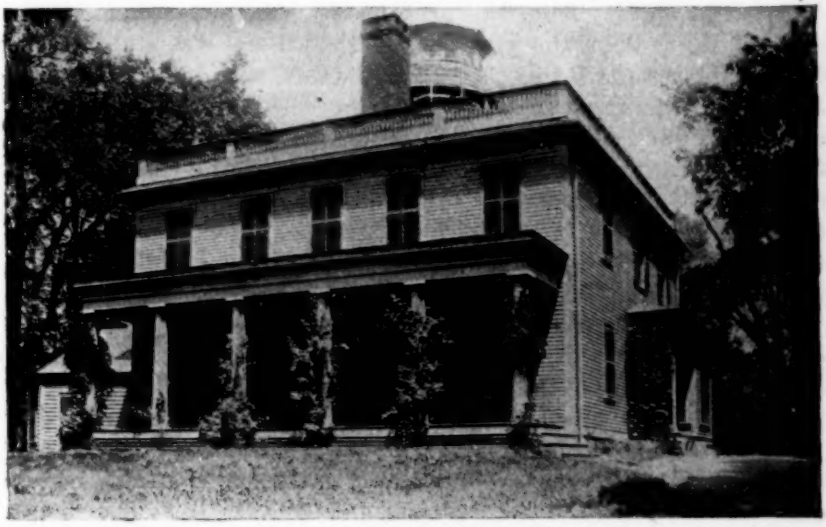
About this time the Navy Department sent out the Wilkes Exploring Expedition, the purpose of which in part was to establish the latitudes and longitudes of uncharted places in distant parts of the world where American commerce was extending, and in part to investigate natural phenomena, including the facts of terrestrial magnetism. In connection with this expedition, Mr. Bond was engaged to make at his private observatory investigations to fix a zero of longitude, whence final reference to Greenwich might be had, and to make a continuous record of magnetic observations at Dorchester for comparison with like records obtained at distant points by the expedition itself. As preliminary to the latter work Mr. Bond tested the magnetic instruments with which the expedition was to be equipped.

Josiah Quincy, who had given Mr. Bond early encouragement, was now President of Harvard College. It occurred to him, to use his own words, "that if Mr. Bond could be induced to transfer his apparatus and residence to Cambridge and pursue his observations there, under the auspices of the university, it would have an important influence in clearing the way for the establishment of an efficient observatory in connection with that seminary."

There was little inducement for Mr. Bond to make the change. His business was prosperous and his home life among friends and neighbors whom he had known for years was very pleasant. The college could offer him no salary—only the use of a house. In his excessive modesty he feared that the arrangement proposed would arouse great expectations that he with the facilities at his command would be unable to satisfy. He made other objections, but all were overcome, and on November 30, 1839, he entered into a contract with the college corporation, agreeing to make the transfer as proposed. A subscription was at once raised for fitting up a dwelling owned by the college to be occupied by Mr. Bond. This building, known as the Dana House, was the first observatory of Harvard College. It still stands upon its original site at the southeast corner of what are distinctively called the college grounds, and is remembered by many Harvard graduates as the residence for a term of years of the Rev. Dr. A. P. Peabody.

Its cupola was placed upon it to accommodate one of Mr. Bond's telescopes, and at that time was suitably domed.

Mr. Bond's chief work at Cambridge for the first two or three years was a continuation and extension of his observations for the Navy Department in regard to the earth's magnetism. He was assisted by his son, W. C. Bond, Jr., whose death in 1842 was regarded as a loss to science. Renewed exertions were now made to secure an adequate observatory and set of instruments. The site was purchased in 1841. A brilliant comet that appeared in 1843 furnished a favorable occasion for raising a subscription. The best telescope that could be produced in Europe, a refractor of fifteen inches aperture, equatorially mounted, was ordered from Merz & Mahler, of Munich, and ground was broken for a pier for it in the summer of the same year. In September, 1844,



THE DANA HOUSE. First observatory of Harvard College.

the instruments were removed from the Dana House to the new observatory, and Mr. Bond entered upon a series of observations for determining the latitude and longitude of the new station.

Mr. Bond's first recorded observation in Cambridge was of date December 31, 1839, and his appointment as director of the observatory dates from February 12, 1840. During the first eight years of his connection with Harvard College he is to be regarded as a benefactor rather than an employee of the institution. The official report for 1846 states that up to that time the labors of Mr. Bond had been "entirely unrequited, except by the gratification of his love of science and of home," and suggest that this devotion to the institution at Cambridge was the more marked in that dur-

ing the preceding spring he had declined "the almost unlimited offers made to him by the administration at Washington to induce him to take charge of the observatory there." It is known also that frequent expenditures of his own money were made during this period for current expenses and for things convenient in conducting the observatory—sums small severally, no doubt, but considerable in the total. In 1846 a sum equal to the proposed salaries for the next two years was subscribed by citizens of Boston, and in 1849 the official board was able to report that "through a bequest of one hundred thousand dollars made by Edward Bromfield Phillips they should thereafter be relieved from anxiety as to the payment of salaries and current expenses."

The fifteen-inch equatorial was set up in June, 1847, and has done splendid service for now nearly half a century. At last the skill of Prof. Bond was furnished with a fitting implement. In reply to an inquiry from Edward Everett, who had become president of the college the year before, Prof. Bond wrote specifying several interesting things that could be seen with it, and ended by saying: "But I must recollect that you require of me only a brief account of our telescope. The objects revealed to us by this excellent instrument are so numerous and interesting that it is difficult to know where to stop." In a subsequent letter he wrote to the president, "You will rejoice with me that the great nebula in Orion has yielded to the powers of our incomparable telescope." Besides this and other nebulæ the planet Saturn was an early subject of investigation. On September 19, 1848, Prof. Bond discovered the eighth satellite of this planet, which long remained the only addition to the solar system made on the continent of America.

When Bond was determining the position of the Harvard Observatory, Commodore Owen, of the British navy, was making an official survey in New Brunswick and Nova Scotia. The latter, desiring to use the observatory as his zero point, co-operated with Bond in making a transfer of twelve chronometers to and from Greenwich, England. Afterward other chronometer expeditions were conducted by Bond in co-operation with the United States Coast Survey, the final one being in 1855. In the summing up of results, seven hundred and twenty-three independent chronometer records were used. The magnitude of this undertaking, as a whole, surpassed anything ever attempted in any other country.

As early as 1848 Prof. Bond mentions, in his report as director of the observatory, some experiments with the daguerreotype and talbotype processes for obtaining pictures of the sun, which, though encouraging, could hardly be called successful. But in his report for 1850 he is able to say: "With the assistance of Mr. J. A. Whipple, daguerreotypist, we have obtained several impres-

sions of the star Vega. We have reason to believe this to be the first successful experiment ever made either in this country or abroad." Some daguerreotypes of the moon and certain stars were exhibited in the World's Fair of the following year at London, and received a council medal.

The inventive skill which won success for Bond as an artisan appears in certain astronomical appliances and methods devised by him. The great telescope is poised thirteen feet above the floor of the observatory's dome. It has a vertical sweep of more than ninety degrees, and can, of course, make a complete revolution about its axis of support. An observer would evidently have to be something of an acrobat to use it successfully, unless a suitable chair could be obtained. There was none in the world that filled all the requirements, so Prof. Bond invented and made one. It is in use unchanged to this day, and by means of its ingeniously combined wheels, cogs, and pulleys the observer can quickly and easily place himself anywhere along the vertical quarter-circle and horizontal full-circle traversed by the eyepiece of the telescope.

Certain experiments for determining differences of longitude by the aid of the telegraph were undertaken by the Coast Survey in 1848, Prof. Bond being one of the special assistants whose services were secured for this work. While engaged in these experiments the idea occurred to him, as it had to one or more others, of using an automatic circuit interrupter in place of human nerves and muscles as the connecting link between the astronomical clock and the electric wire. Fear of injuring the clock had prevented the use of such a device, but Prof. Bond obtained authority to have a clock made especially for this work, at the expense of the survey. This was done, and the device was found to operate perfectly and without injury to the clock. "But another and far more serious difficulty presented itself," says Prof. Bond, referring to this matter in one of his reports, "in the accurate registry of the beats of the clock after being transmitted by the galvanic circuit; and it was at this point that further progress in the application of this method to astronomical observing was arrested." Attempts to overcome this difficulty were made by various inventors in the course of the next two years, but nothing satisfactory came of it before April 12, 1850, when Bond submitted to the Coast Survey an apparatus invented by him and his sons George P. and Richard F. Bond. It was named at first, from one of its peculiar parts, the "spring governor," but the more comprehensive title of "chronograph" was applied to it later. The apparatus was at once adopted for use by the survey. It was taken by Mr. G. P. Bond on his tour to Europe of the next year and exhibited before the Royal Astronomical Society of England and the

British Association for the Advancement of Science. Through the urgency of Sir David Brewster and others it was set up in the great exhibition of that year in London, where a medal was awarded for it. It was adopted at the Greenwich Observatory soon after, and speedily throughout Europe. The use of the "circuit interrupter" and the "chronograph" together constitute what became known in Europe as "the American method" of recording observations. Through it the errors for which the "personal equation" is a partial remedy are largely eliminated, and a superior definiteness of record is attained.

Soon after the electrical experiments of 1848, the "circuit interrupter" was put to use at Cambridge in transmitting to Boston and other points in New England the true local time. This was the beginning of the Harvard Observatory time-service, which was systematically organized in 1872. This idea was also early adopted at Greenwich.

In 1852 the officers of the Harvard Observatory co-operated with Captain Charles Wilkes in experiments for ascertaining the velocity of the sound from the discharge of cannon under different atmospheric conditions. The object of this investigation was to secure accurate values for some of the data obtained by the exploring expedition, the measurement of distances in some cases having been made by firing cannon.

One of the important events in the latter part of Prof. Bond's directorship of the Observatory was the beginning of the publication of The Annals of Harvard College Observatory. This was made possible by an endowment of ten thousand dollars given in 1855 by Josiah Quincy, ex-president of the college. The first of these noble quarto volumes was issued in the following year, and embodied a review of the work of the preceding years, so that the whole series makes a continuous record from the establishment of the observatory.

Prof. Bond died January 29, 1859, and was succeeded in the management of the Observatory by his son, George Phillips Bond, who had been one of his assistants for many years. The elder Bond had entered vigorously into the scientific life of his time, and his labors were duly appreciated by his associates and contemporaries. He was a member of the American Academy of Arts and Sciences, the American Philosophical Society, and the Royal Astronomical Society of England. From Harvard College he received the honorary degree of A. M. in 1842.

EDITOR'S TABLE.

SOCIAL EVOLUTION.

A RECENT writer, whose work has been very much discussed, tells us that social evolution depends more on the kind of religion a community possesses than on any other circumstance. A given community, provided with a suitable religion, will far outstrip in civilization another more richly endowed intellectually but with an inferior religion. Like all new formulas, this one has been having considerable vogue; and many persons whose strong point is not intellectuality are gratified to think that a snub has been administered to that aggressive quality. What we should like the able author to do would be to supplement his generalization by telling us how the suitability of a religion for purposes of social evolution is to be determined, and also how a community that is not in possession of the right kind of religion is to get into possession of it. Another question which the work undoubtedly suggests is how the right kind of religion is to be maintained in authority against the intellectual influences which the writer seems to say tend to undermine all religions. As Greece and Rome both reached a very high level in civilization, we must presume their religions were relatively superior—at least in the sense of being favorable to social evolution to those of less distinguished races; but their religions decayed. Was any one to blame in the matter? Or was the decay in each case inevitable? Was it a needful preparation for the advent of a still higher form of religion? If so, what is to be done when other forms of religion seem about to undergo transformation? Should we try to arrest the process, or let things take their course?

These are entirely practical questions, on none of which does the author to whom we are referring* throw, or attempt to throw, any light. They are not only practical questions, but they are questions which any thoughtful man finds it impossible not to ask when confronted with Mr. Kidd's formula; and which he feels must be answered in a very definite manner before it can prove of any utility either for the interpretation of history or for guidance in the present. What we would suggest would be an amendment to the formula which we think would greatly increase its applicability both to the past and to the present course of events. If we are allowed to understand by religion the ideal of social duty, then it seems to us very true that social evolution will, in the long run, be mainly dependent thereon. What made Rome great was the social cohesion between her citizens. How this superior degree of social cohesion was in the first place produced would be one of the most obscure of historical problems; but that it existed and was largely the cause of the growth of the Roman power can not be doubted. Devotion to the state and faith in its fortunes were in reality the most important elements in the religion of an ancient Roman. His gods were in the fullest sense civic gods, and as civic—that is to say, local—gods merely he regarded those of other races. The virtues which he esteemed and reverenced were those which made for the strength

* Kidd. Social Evolution.

and well-being of the state; and only in later years, when the ancient forms of faith were undergoing a process of disintegration, did any conception of virtue for virtue's sake, or of the connection of virtue with the wider interests of humanity, dawn on the Roman mind.

In dealing with this subject, however, our object was neither to criticise Social Evolution nor to discourse on the civilization of the ancient Romans: on the contrary, we had an entirely "modern instance" in view. If social evolution depends in large measure on the ideal of social duty existing in each community, it behooves us to consider carefully what ideals are growing up and taking root among ourselves. We believe that, making all abatements for conspicuous evils in the social state, there is a steady evolution taking place—that is to say, that the conditions of social life are improving on the whole from year to year. The principal drawbacks to such evolution are undoubtedly connected with our political life. One of the ablest of our contemporaries makes a duty of holding up the mirror to the evils and scandals which mark the course of politics in this State; and the picture presented is not encouraging. "In the belief," it says, "of nearly all the intelligent portion of our population the meeting of the Legislature in January is simply the opening of a school of vice. As soon as the Speaker is elected the members organize for the sale of legislation in quantities to suit purchasers or for the levy of blackmail." We do not fully indorse these words; but that they should be uttered at all by a responsible journal is significant and lamentable. The question is urgent: What can be done to create a deeper sense of responsibility in the public mind in regard to the conduct of political affairs? No community can permanently afford to have a disreputable legislature. While other agencies are at work to improve and purify the social state, here is one of the greatest magnitude which is operating in an opposite direction—filling the minds of young and old alike with the idea that social duty is an illusion, and that fraud has no meaning when practiced at the expense of the State. We talk of teaching "civics" in our schools, but something more than a school teaching of civics is required. We have vast organizations of a Christian character throughout the land—societies of Christian Endeavor and the like. What are they doing to purify politics? We believe in evolution, but not as a power that will save people from the consequences of neglecting their most important duties; and we think the time has come when communities should help forward their own evolution by conscious efforts to abate what is evil and encourage what is good. We commend the question we have raised to the consideration of all well-intentioned persons. The problem is how to prevent politics from corrupting the character of our citizens and antagonizing the efforts that are made in other spheres for social reform and improvement. It is a question for every one—for the wise and for the ignorant, for the man of science and the man of letters, for the theologian and for the journalist, for the man of business and the teacher of youth. What is needed is a concentration upon it of the attention and will of right-minded persons—of that large majority who have no sinister interests to serve by the abuse of political influence, and who ought to have enough regard for the national well-being to be willing to make some sacrifices on its behalf. If these will but do their duty, a solution of the problem will be found; but if, unfor-

tunately, their other engagements, whether of business, pleasure, or religion, are too pressing to permit them to do so, there is much reason to fear that the poison generated by corrupt politics will seriously affect the whole life and growth of the community.

LITERARY NOTICES

A MANUAL FOR THE STUDY OF INSECTS. By JOHN HENRY and ANNA BOTSFORD COMSTOCK. Ithaca, N. Y.: Comstock Publishing Co. Pp. 701. Price, postpaid, $4.09.

A SUBSTANTIAL service has been done to teachers and students of entomology in the preparation of this handsome, systematically arranged work by Prof. and Mrs. Comstock. Besides describing the important insects of each order, the authors have undertaken to provide an analytical key of insect species similar to those which the student of plants finds so helpful and interesting. But while much pains has been taken to render easy the classification of specimens, the mere determination of their names has been treated as a matter of slight importance. The authors warn the reader against expecting in this volume such an approach to completeness as exists in the manuals of flowering plants. A work containing adequate descriptions of all the species in our insect fauna, they say, "would rival in size one of the larger encyclopædias." The general mode of treatment consists of a discussion of the characteristics of each order and the families composing it, with descriptions of the commoner species as illustrations of the several families. Simplicity has been studied in the descriptions, though not at the expense of accuracy, morphological terms have been reduced to a minimum, and so far as possible a uniform nomenclature has been used for all orders of insects. Writers confining themselves to single orders have developed differing nomenclatures, which is confusing to the student in passing from one order to another. Prof. Comstock has made as near an approach as practicable to uniformity in this respect, as a consequence of which, homologies heretofore above the grasp of any but advanced students, as in the wing-veins, are now brought forcibly to the attention of the beginner. The technical terms from Greek and Latin, which are a great bugbear to many beginners in the study of science, have been robbed of half their terrors by marking the syllabic division and the accent of each the first time it occurs. Most of the eight hundred woodcuts in the volume have been engraved from Nature by Mrs. Comstock, who has also furnished a part of the text. An attractive frontispiece in colors represents several butterflies and other insects about a thistle-head and a spray of golden-rod. The book is issued at a low price considering its size, its large number of illustrations, and the excellence of its manufacture.

THE EDUCATION OF THE GREEK PEOPLE AND ITS INFLUENCE ON CIVILIZATION. By THOMAS DAVIDSON. International Education Series, Vol. XXVIII. New York: D. Appleton & Co. Pp. 229. Price, $1.50.

THE purpose of the author in this volume is "to show how the Greek people were gradually educated up to that stage of culture which made them the teachers of the whole world, and what the effect of that teaching has been." After an introductory chapter on the aim and general form proper to education, he outlines the life of the Greeks and its ideals. He traces the Greek citizenship from its patriarchal and tribal origins, and finds *worth*—"the worth of the individual as a member of society"—to be the Greek ideal in life. To this conception was added, when leisure came, the ability to employ that leisure in elevating avocations (diagoge). The nature of education, both before and after the rise of philosophy, is then sketched. In the earlier times much attention was given to physical culture, and for young boys music had almost equal prominence. Competitive exercises evidently were not feared. The mother-tongue and its literature were thoroughly studied, but we find no mention of any time whatever being devoted to the grammars of other languages, dead or living. Youths learned political science by observation of the conduct of public affairs by their elders. After the philosophical era began individual happiness came to rival civic worth as an end of activ-

ity, and all sorts of knowledge were cultivated under the tuition of the Sophists. Then came Socrates, who largely counteracted the charlatanry into which the Sophistic teaching had degenerated. Our author next discusses the attempt in Plato's Republic to plan a state with a basis in philosophic principles, and that of Aristotle, whose basis was inductive reasoning. Both of these he sets down as failures. He then shows how Greek culture was influenced by contact with the two great religions of the Eastern world, Zoroastrianism and Judaism, and with the statesmanship of Rome. In conclusion the author affirms that the Greeks, through their scheme of culture, "not only lifted the world out of barbarism, but it requires their influence even to this day to prevent it from falling back into the same." What he regards as the error that was fatal to the Greek civilization was placing philosophy on the throne that should have been given to religion. This book is designed as a guide in teaching, but if it were itself put into the hands of students it would give more insight into Greek thought than digging out many pages telling what number of parassangs the army marched day by day or what was done by "wily Odysseus," aided by "ox-eyed Athenæ."

THE WRITINGS OF THOMAS PAINE. Collected and edited by MONCURE DANIEL CONWAY. Volumes II and III. New York: G. P. Putnam's Sons. Price, $2.50 a volume.

POLITICAL and sociological essays make up these two volumes; Volume II covering the period from 1779 to 1792, and Volume III extending from 1791 to 1803. The most extended of these writings is the Rights of Man, which occupies half of Volume II. The two parts of which it is composed were written in a controversy with Edmund Burke *à propos* of the French Revolution and embody a full and careful statement of republican principles. The same volume contains Paine's pamphlet published in 1782 under the title, Letter to the Abbé Raynal, on the affairs of North America: in which the Mistakes in the Abbé's Account of the Revolution of America are Corrected and Cleared up. Paine was in England or France for fifteen years of the period covered by these volumes, having gone abroad in 1787 to introduce a form of bridge that he had invented. He was active in establishing the French Republic, though opposed to its extreme measures, hence many of the essays in both volumes relate to French affairs Among the American questions treated are: The United States Bank, paper money, the Newfoundland fisheries, and the purchase of Louisiana. Paine's religious writings, his poems, and some letters and scientific fragments are reserved for the fourth volume.

PROCEEDINGS OF THE SOCIETY FOR PSYCHICAL RESEARCH. Part XXVI. Dr. Richard Hodgson, 5 Boylston Place, Boston, Mass., American Secretary. Pp. 466.

THIS number of the society's Proceedings is mainly occupied by the Report of the Census of Hallucinations taken by a committee of which Prof. Henry Sidgwick was chairman. Seventeen thousand answers were obtained to the question, "Have you ever, when believing yourself to be completely awake, had a vivid impression of seeing or being touched by a living being or inanimate object, or of hearing a voice; which impression, so far as you could discover, was not due to any external physical cause?" About ten persons in a hundred were found to have had such experiences. Accounts of a large number of these occurrences, for the most part written by the percipients, are included in the report. The differences between hallucinations and other phenomena with which they are liable to be confounded are pointed out by the committee and illustrated by cases. Passing from merely subjective hallucinations, the committee discusses those of a veridical character—i. e., such as "can only be accounted for on the hypothesis that impressions or impulses have reached the percipient's mind otherwise than through the recognized channels of sense." A large number of these, and by far the most impressive class, occur at, or within a few hours of, the death of the person whose figure seems to be seen or voice seems to be heard. Another impressive class of cases is those in which the hallucination is experienced at the same moment by two or more persons. The evidence gathered through the census has been carefully sifted, and after rigid requirements have been satisfied there remain enough facts to satisfy the com-

mittee that "between deaths and apparitions of the dying person a connection exists which is not due to chance alone." Some other remarkable cases seem to indicate action on the part of the dead, but the committee does not deem them anything like sufficient to establish *post mortem* agency.

MANUAL OF GEOLOGY. By JAMES D. DANA. Fourth edition. New York: American Book Company. Pp. 1088.

PROF. DANA'S Manual has been an authority for a generation, its first edition having appeared in 1863. It has always been of especial value to American students from the fact that it has treated geology with especial reference to American geological history. In the new edition, for which the work has been wholly rewritten, this feature has been preserved. Historical geology, in fact, occupies about two thirds of the volume, three hundred pages being devoted to the dynamical side of the science, while the physiographic and structural divisions together occupy one hundred. So many new facts and hypotheses have been brought forward in the last fifteen years that the author felt obliged to increase the quantity of matter, both text and illustrations, in the book by fifty per cent. A peculiar interest attaches to this edition from the death of Prof. Dana two months after completing the supervision of its publication. It is fortunate for students of geology that he was able to finish his task.

THE ASTROPHYSICAL JOURNAL. An International Review of Spectroscopy and Astronomical Physics. Vol. I, Nos. 1 and 2, January and February, 1895. GEORGE E. HALE and JAMES E. KEELER, Editors. Chicago: University of Chicago Press. Pp. 100. Annual subscription, $4.

THE plan of this journal was conceived by Mr. Hale several years ago, but was modified on consultation with Prof. Payne, of the Sidereal Messenger, and a union of forces resulted in the publication, in January, 1892, of the periodical Astronomy and Astrophysics. This periodical was, during three years, a leading organ of astronomical research, and its career was highly creditable to American science. A separation of interests has now taken place, Popular Astronomy being continued as a journal of the character indicated by its title, and Mr. Hale returning to his original plan of conducting a journal of Astronomical Physics. In preparation for this undertaking the co-operation of eminent astronomers the world over has been secured, and besides those of its editors in chief the Astrophysical Journal bears the names as assistant editors of J. S. Ames, of Johns Hopkins; W. W. Campbell, of the Lick Observatory; Henry Crew, of the Northwestern University; E. B. Frost, of Dartmouth College; and F. L. O. Wadsworth, of the University of Chicago; and as associate editors, of ten eminent working astronomers in Europe and America. The scope of the journal includes all investigations of radiant energy, whether conducted in the observatory or in the laboratory—especially photographic and visual observations of the heavenly bodies, spectroscopic, photometric, bolometric, and radiometric work of all kinds; descriptions of instruments and apparatus used in such investigations; and theoretical papers bearing on any of these subjects.

A TEXT-BOOK OF INVERTEBRATE MORPHOLOGY. By J. PLAYFAIR MCMURRICH, M. A., Ph. D. New York: Henry Holt & Co. Pp. 661. Price, $4.

A STUDENT of the invertebrates will welcome this new work by Prof. McMurrich. The various subdivisions are fully discussed, and an excellent bibliography follows each group. The illustrations are abundant enough and in the main clear, though one would wish for better drawings, some of which, especially in the Mollusca, are positively bad. In a work of so comprehensive a nature the author would have avoided many minor mistakes if he had submitted each section to a specialist. Under the Brachiopods we are told that the shells are similar to those of the Lamellibranchs, whereas neither in origin, structure, nor position is there the slightest similarity. In stating the composition of the Brachiopod shell as carbonate of lime he overlooks Lingula, in which the composition is phosphate of lime. He says there are no organs of hearing in Brachiopods, while Lingula has very distinct auditory vesicles. He states that the circulation is induced by the contraction of the body wall, whereas circulation is due to the ciliary lining of the lacu-

næ. A flushing of the lacunæ, so to speak, takes place now and then when the shells open and close.

The author has frankly stated in his preface that the book must necessarily be tinged with his own opinions, and therefore the reviewer can only express disagreement with the position he has assigned to certain groups, notably the Lamellibranchs, Echinoderms, and Amphioxus, and to the use of the word type. Despite the minor errors, which can be corrected in a subsequent edition, we heartily commend the book, and congratulate the author for his fairness in accrediting drawings to their proper source.

ELEMENTS OF MINERALOGY, CRYSTALLOGRAPHY, AND BLOWPIPE ANALYSIS FROM A PRACTICAL STANDPOINT. By ALFRED J. MOSES, E. M., Ph. D., and CHARLES L. PARSONS, B. S. New York: D. Van Nostrand Company. Pp. 342.

A THOROUGH and systematic study of mineralogy is the ideal of this book. The part on crystallography is illustrated with one hundred and seventy-one figures; it describes the use of the hand and the reflection goniometers, and contains a chapter on clinographic projection of crystal figures. The symbols of Weiss, Naumann, Dana, and Miller are given with the several forms. The chapters on blowpipe analysis include systematic schemes of operation. More than half of the volume is devoted to descriptive mineralogy, in which, after some account of the physical and chemical characters of minerals, the species are taken up by groups, as the iron minerals, the manganese minerals, zinc and cadmium minerals, etc. As the book is made from a practical standpoint, the chief uses and localities of each mineral are included in its description. This part is also fully illustrated with forms of crystals, bringing the whole number of figures up to three hundred and thirty-six. A series of tables for determinative work and two indexes complete the volume.

A large fund of information about public affairs is crowded into *The Daily News Almanac and Political Register for 1895* (Chicago, 25 cents). It includes rates of the old and new tariffs, statistics of imports and exports, of manufactures, agriculture, mortgages, the liquor trade, pensions, etc., etc.; accounts of the labor disturbances, the Hawaii affair, and other matters; a register of the national Government, the army, navy, and diplomatic service, important legislation by Congress, election returns, events of the year, including sporting events, and many other things that it is often convenient to refer to.

The Aëronautical Annual for 1895, edited by *James Means* (W. B. Clarke & Co., Boston, $1), is made up largely of historic matter. Some account of Leonardo da Vinci is given, with reproductions of his mechanical drawings and extracts from his Treatise upon the Flight of Birds. This is followed by essays on aërial navigation, by Sir George Cayley, Bart., published in 1809 and 1810, by Thomas Walker in 1810, by F. H. Wenham in 1866; Benjamin Franklin's aëronautical correspondence, 1783 to 1786; and some minor fragments. There are also a bibliography of aëronautics, an essay on The Problem of Manflight, by the editor, 1894, and an editorial article on the prospects of aëronautics. The volume is illustrated with reproductions of many quaint engravings.

The *Smithsonian Geographical Tables*, prepared by *R. S. Woodward*, is an outgrowth and further development of the idea embodied in the meteorological tables prepared by Dr. Arnold Guyot, at the request of Prof. Henry, and published in 1852 in the Smithsonian Miscellaneous Collections. This work passed through four editions, the last having been published in 1884. This edition was exhausted in a few years, and a recasting, rather than a revision, of the work was called for; and it was decided by Prof. Langley to publish the new work in three parts—Meteorological Tables, Geographical Tables, and Physical Tables—each representative of the latest knowledge in its field, and independent of the others. The Meteorological Tables were published in 1893. The present is the second work in the contemplated series. It includes an introductory part and tables. The introductory part is divided into seven sections under the heads Useful Formulas, Mensuration, Units, Geology, Astronomy, Theory of Errors, and Explanation of Source and Use of Tables. The forty-two tables, involving various factors of geodetical and astronomical measurement, occupy one hundred and seventy pages.

The Catholic University Bulletin is a new quarterly publication, conducted by professors of the Catholic University of America, Washington, similar in scope to the reviews and other periodicals which it is now becoming customary for American institutions of learning to issue. Its object is to convey to those who are interested in the university a knowledge of what is being done by its professors and its students; and it will make known the work of the administration so far as it is of public interest; its material progress, benefactions, gifts, etc.; facts relative to the system of teaching and results obtained; descriptions of the special schools and their operation, and the progress made by professors and students in the sciences for which the schools were opened; methods of teaching, educational discussions, and comparative notices of the work of other institutions; articles on higher pedagogics; public official documents concerning the university; literary and biographical notices, necrologies of men of learning deceased, accounts of learned congresses, etc.

A *History of Higher Education in Rhode Island*, prepared by *William Howe Tolman*, Ph. D., is number eighteen of Herbert B. Adams's series of contributions in the Bureau of Education to American Educational History. The educational history of this State is of particular interest because it raises the question whether religious freedom reacted favorably on the establishment of a system of education in the early days of the New England colonies—and helps answer it. The first part of the essay gives an account of colonial and later education. The second part tells the story of the academies and preparatory schools, of which seven are described. The third part is devoted to the institutions for the education of women. The story of Brown University—the only university in the State—occupies the main part of the history, and is told for the most part in connection with the work of the institution's eight presidents. Lastly, the College of Agriculture and Mechanic Arts is represented; and two pages are given to a bibliography.

In the handsome *Geological Map of Alabama*, by the State Geologist, *Eugene A. Smith*, the formations are clearly shown in distinct coloring, which is also harmonious and agreeable to the eye. In the accompanying description and explanatory chart, which corresponds with the map in size and form, the formations, names, synonyms, classification, and common fossils; thickness, lithological and topographical characters, area and distribution; useful products, soils, characteristic timber growth and agricultural features; and the reports in which these features are described, are conveniently shown for ready reference in parallel columns. Mr. Smith's reports, of which we have had many, all bear the marks of good work.

The thirteenth volume of the *Bulletin of the United States Fish Commission*, 1893, contains the proceedings of the World's Fisheries Congress, which was held in Chicago in October, 1893, and the papers that were read there. These papers, represented by forty-nine in the volume, touched various fishery topics, and in many cases called out considerable debate. The same subject gave rise to the expression of divergent opinions, especially on some phases of the commercial fisheries, which demonstrated that a fair conclusion on any of the subjects discussed can be reached only after a careful consideration of all the views presented. The papers given in the volume, being the views of representative men upon the subjects treated, are necessarily of great practical worth, and are published by the Fish Commission with the idea of furnishing the general public with valuable information concerning the fishery industry, and not with any view of approving or disapproving the opinions expressed. Some of the papers are handsomely illustrated, particularly that of Mr. G. F. Kunz, on pearls.

With 1895 the *Journal of the American Public Health Association* takes the place of the annual volume of the association's Transactions. It is issued quarterly from Concord, N. H., at $5 a year. The number for January contains the addresses delivered and part of the papers read at the meeting of 1894, in Montreal. Most of the papers in this number deal with water supplies; two others treat of diphtheria epidemics; and there is one, in French, on the general subject of preventive inoculation.

A plan for teaching science in public schools drawn up by Dr. *William T. Harris*

for his report as Superintendent of the St. Louis Schools, in 1871, was afterward published in book form under the title *How to teach Natural Science*, and now appears in a second edition (Bardeen, 50 cents). It would undoubtedly give very practical help to a teacher confronted with the problem of adding science to the subjects usually taught in common schools, but if Dr. Harris were to rewrite it at the present day, in the light of the advances in science teaching made during the past quarter century, he would probably modify it somewhat. He would not omit to mention the peculiar mental discipline that the study of science affords as a reason for including it in a course of study; he would hardly say that science should "afford relief from the other studies, and not be placed in the same rank with them"; and while in this plan he insists that the teacher rather than a text-book should be the pupil's source of information, he would now probably go further and say that the pupils should get their knowledge of natural objects mainly from the objects themselves.

In the mathematical series of text-books by *John H. Walsh*, noticed several months ago, the *Elementary Arithmetic* includes notation, numeration, and the "four rules," the latter being applied in denominate as well as abstract numbers although no tables are given. The arithmetical processes dealt with are exemplified in a great variety of ways, including the use of many practical problems suited to the understanding of young pupils. (Heath, 40 cents.)

The first edition of *Joint-metallism*, by *Anson Phelps Stokes*, noticed in our January number, has been followed by a second and this by a third edition, each being an extension of its predecessor (Putnams, $1). Of the new matter, Part II consists of further arguments for joint-metallism and against bimetallism and monometallism. Part III is historical, giving views of writers on the science of money, beginning with Oresme, who wrote about 1366. In Part IV too great reliance on credit is deprecated and objections to the author's plan are answered.

The eleventh edition of the *Advertiser's Handy Guide* (1895) has been received (L. D. Morse Advertising Agency, New York, $2). It contains the names of the important journals of all the States and Territories of the United States, also those of the Dominion of Canada, in alphabetical order under each State or province. The circulation, politics, and frequency of issue of each paper are given, also the population of the city or town and county in which it is published. In addition to the general list there are separate lists of agricultural, medical, religious, etc., journals and other information valuable to advertisers. The volume contains seven hundred and eighty-six pages and is of handy size—about four by seven inches.

An Introduction to English Literature (Henry Holt & Co., New York), by *Henry S. Pancoast*, is based upon the author's previously published Representative English Literature, enlarged in some directions and curtailed in others, in order to adapt it to somewhat different requirements. It is intended to meet the needs of teachers who may wish to use the historical and critical portions of a book like that one, without being restricted to the prescribed selections which it gives as representing the successive literary epochs. To this end about two hundred pages of new matter have been added, and the notes and selections in the former work omitted. It is still the author's object to send the student directly to the literature itself, which is done here by suggesting in reading lists the selected works, giving them in some instances with general hints for study.

Volume IX of the Contributions to North American Ethnology published by the United States Geological Survey is the *Dakota Grammar Texts and Ethnography*, prepared by *Stephen Return Riggs*, and edited after the author's death with the copy not revised, by J. Owen Dorsey. Mr. Dorsey contributes a preface embodying interesting information concerning the structure, etc., of the language. The texts include eight Dakota myths, Dakota and English interlined, with translations following, the Parable of the Prodigal Son, The Lord's Prayer, and the Fourth Commandment. In the Ethnography are chapters on the Tribes, the Migrations, the Dakota Gens and Phratry, Unwritten Dakota Laws, The Superhuman, Armor and Eagle's Feathers, and Dakota Dances.

The *First Latin Readings*, selected and compiled by *Robert Arrowsmith* and *George*

M. Whicher (American Book Company, $1.25), is an attempt to respond to the call for variety in the Latin authors read in American preparatory schools. It aims, in introducing the student to the literature of the Romans, by presenting attractive and varied material, to arouse the desire for further acquaintance with that literature; to cultivate in him an appreciation of the beauties of language and instruction; and to help him gain, besides a mastery of the mechanism of the language, an insight into the thought and life of the people. The selections have been carefully made with reference to their difficulty, their interest as literature, and, in great part, their relation to Roman life and customs. Eutropius, Cornelius Nepos, Cæsar, Aulus Gellius, Cicero, and Livy are represented.

Roderick Hume; the Story of a New York Teacher, has been written by Mr. *C. W. Bardeen* to depict certain phases of the modern union school. The author says that he has no hobby to ride and no grievance to redress, but has merely described what he has seen, trusting his fancy just far enough to weave into one web characters and incidents that were real but disconnected. (Syracuse, N. Y.: C. W. Bardeen, 50 cents.)

A little book on *Varied Occupations in Weaving* has been prepared by *Louisa Walker*, head mistress of Fleet Road Board School, Hampstead (Infants' Department), for kindergartens. The work described in it has been systematically taught in the author's own school for the past twenty years. The ways and means employed in constructing the articles illustrated have been adapted to meet the exigencies of each case, and simplify matters for little workers. The illustrations are from actual work produced in the school. The entire weaving was done by infants of from five to seven years of age, and the material was afterward manipulated into useful articles by the teachers. (Published by Macmillan & Co., $1.)

The National Geographic Society has arranged for a series of geographical monographs on the physical features of the earth's surface, to be published monthly during the school year, at 20 cents each, or $1.50 for the ten. The first two of these monographs are by Major *J. W. Powell*. The first describes *Physiographic Processes*, treating the atmosphere, waters, and rock formations as envelopes of the earth continually in motion and pointing out the processes by which, through the action of the forces generated, the principal features of the earth's surface are produced. The second is on the *Physiographic Features* of the earth, and is an attempt to characterize these mainly as they are dependent on the three great physiographic processes, and to show how fire, earthquake, and flood have been involved in fashioning the land and the sea.

The *Annales de la Oficine Meteorologica Argentina* (Argentine Weather Office), of which *Walter G. Davis* is director, at Rosario, South America, embodies the results of observations made three times a day at thirty regular stations, and voluntary rain observations made by station agents at sixty-nine stations on the four principal railroads of the republic. The observations, recorded in tabular form, fill a large volume.

The *Geological Atlas* of the United States, now being published in parts called folios, consists of topographical and geological maps. The complete atlas will consist of several thousand folios, each of which contains a topographical and a geological map of a small section of country, and will be named after some well-known town or natural feature within the limits of the district named. The topographical maps will show the reliefs, drainage, and cultures of the districts, indicated by the usual or definite conventional marks. The geological maps will show on distinct sheets the areal geology, or the areas occupied by the various rocks of the district; the economical geology, or the distribution of useful minerals; the occurrence of artesian water, and other facts of economical interest, showing their relations to the features of topography and to geological formations; the sheet of structure sections will exhibit the relations existing beneath the surface among the formations the distribution of which on the surface is represented in the map of areal geology; and the sheet of columnar sections will contain a concise description of the rock formations which constitute the local record of geological history. To each of these maps is attached a legend fully explaining all the conventional signs, marks, and colors used in it; and each folio contains a descriptive

letterpress. Of these folios, each containing the six sheets, we have received No. 1, Livingston, Mon.; No. 2, Ringgold, Georgia and Tennessee; No. 3, Placerville, Cal.; No. 6, Chattanooga, Tenn.; and No. 7, Pike's Peak, Col., to be supplemented by a special detailed map of the Cripple Creek district. Each folio is provided with stiff paper covers and cloth backs.

In a little book by *Florence Bass*, in the Nature Stories for Young Readers, entitled *Animal Life*, the subjects are mainly such insects or other animals as the children may observe for themselves. The lessons aim to give illustrations of some of the varied means of self-protection employed by animals; their methods of home building and of caring for their young; the transformations they undergo; the adaptability to their surroundings and coverings; and the "tools" with which the various animals are provided. It is intended to interest children in the animals, and to make them averse to giving them pain and to killing them. (Published by D. C. Heath & Co., 35 cents.)

Regents' Bulletin (of the University of the State of New York), No. 25, contains the secretary's report, with special papers on University Institutions, certain special topics, department reports, and notices of higher educational meetings; No. 28 contains the proceedings of the Thirty-second University Convocation, held July 5 to 7, 1894. Nos. 24, 27, and 29 are specially numbered as Extension Bulletins Nos. 6, 7, and 8. The first comprises the report of the Extension Department for 1893, with the circulars issued and other items of information; No. 27 is a record of the progress of extension teaching; and No. 29 embodies accounts of summer schools in 1892–'93; in New York; other American schools; and foreign schools. The whole number of schools represented is a hundred and five.

Three plates of Enlargements of Lunar Photographs (*Agrandissements de Photographies lunaires*) published by *W. Prinz*, of the Belgian Royal Observatory at Uccle, are phototypic reductions, without retouching, of some of the enlargements which were presented by the author to the Belgian Academy of Sciences in April, 1892. They represent photographs taken with the great refractor of Lick Observatory, enlarged from ten to a hundred times, and among other things they illustrate the richness in details of the views taken with that instrument. They are of special value as permitting a closer study of the details of lunar relief—a study which, it is hoped, may cast some light respecting the origin of terrestrial reliefs. A question of priority is connected with this publication, which is made partly to enforce M. Prinz's claims and partly as a specimen of a proposed atlas. The photographs represent the circle Copernicus, the crater Bullialdus, Mare Humorum, and Mare Imbrium. Sent gratis to astronomers and observatories.

Nos. 14, 15, 16, and 17 of the Contributions to American Educational History, published by the Bureau of Education, under the editorial direction of Herbert B. Adams, present the *History of Education in Connecticut*, by *Bernard C. Steiner*; *Delaware*, by *Lyman P. Powell*; *Higher Education in Tennessee*, by *L. S. Merriam*; and *Maryland*, by *B. C. Steiner*. The histories are constructed in general on a common plan, beginning with the first establishment of schools in the State, tracing their development in the colonial or territorial period and under the State government; describing the more important academies and the colleges, and then the principal special and technical schools. The story of education in Connecticut is of peculiar interest; for that State was a pioneer in the establishment of public schools, which are almost coeval with its existence, and is still behind none.

In the Delaware history a logical rather than a chronological order is followed. The beginning of educational enterprise is traced to the middle of the seventeenth century, under the Swedish, Dutch, and English settlers; education in the towns is considered; next the colleges; then public education from its origin in 1796; and the education of the negro.

The history of higher education in Tennessee is in the main the history of private initiative and activity which has been characterized by broad liberality and farsightedness. By these means the State has become the seat of an exceedingly interesting and creditable group of academies and colleges of all kinds, and Nashville an important educational center. Of these institutions,

not the least in importance and fame are the schools for negroes.

Maryland has not obtained wide renown until recent years for its higher institutions of learning, yet the number and importance of them have been too great to justify such neglect as they have received. Though the early conditions of life in the colony were not such as to favor schools or colleges, a plan for a college was brought forward as early as 1791—the fourth attempt for a college in the United States—but no college proved successful till Maryland became a State.

It is claimed by Director Powell, in presenting the *Twelfth Annual Report of the Bureau of Ethnology*, covering the year 1890–'91, as a noteworthy feature of the plan under which the work of research is conducted, that the ethnologists who, as authors, prepare the publications of the bureau, personally gather the material for them in the field, supplementing this material by a study of all the connected literature and by a subsequent comparison of all ascertained facts. The continuance of the work for a number of years by the same zealous observers and students, who freely interchange their information and opinions, has resulted in their training with the acuteness of specialists, corrected and generalized by the knowledge obtained from other authorities on the same or related specialties. The present report is an excellent example of the application of this method of work. The substance of it, after the routine matter is disposed of—otherwise the "accompanying paper"—is a Report on Mound Explorations, by Dr. Cyrus Thomas, a veteran laborer in this field, who brings to the task of reviewing the whole subject all the advantages that long experience in field and study work can bestow. The explorations reviewed cover eighteen States in the Mississippi Valley, Atlantic coast, lake, and eastern central regions, supplemented by papers on archæological areas and distribution of types, the mound-builders and comparison of their works with those of the Indians, and evidences of contact with modern European civilization found in the mounds, with 344 illustrations.

In *Le Centre de l'Afrique, autour du Tchad* (The Center of Africa, around Lake Chad), the story of the journeyings of the Maistre French expedition to the region in question is told by M. *P. Brunache*. The object of the expedition, departing from the Congo, was to reach the Chari River and form relations with the Mussulmans of the Chad Valley. The expedition did more than this, for, having reached Palem beyond the Chad, through a country which no European had ever penetrated, it continued on through a region equally virgin to European exploration to Guéroua, and thence diverting from the Binerée to strike it again at Ibi, down that river and the Niger. It made several geographical discoveries of interest; corrected some errors; made treaties with numerous fetich chiefs; and collected anthropological data and material. Published by Félix Alcan, Paris, in the Bibliothèque Scientifique Internationale.

Les Aurores Polaires (Polar Auroras), of M. *Alfred Angot*, has been developed by revision and expansion from a series of articles published in the periodical *La Lumière Electrique* in 1882. All is brought up to date. The history of auroral observations is told, and the theory of the lights is discussed with the clearness of style and facility in explanation that have given the author an eminent position in scientific literature. Numerous carefully executed engravings illustrate some of the most remarkable observations of auroras. A list is appended of auroras observed from 1700 till 1890, in Europe, south of latitude 55°. The work is published by Félix Alcan, in the French edition of the International Scientific Series.

We have already spoken twice of the *Dictionary of Birds*, prepared by *Alfred Newton* and *Hans Gadow*, with the assistance of eminent English naturalists, and Dr. R. W. Shufeldt as American contributor, published by the Blacks in London, and Macmillan & Co., New York. The work is continued in Part III, from Moa to Sheathbill. The matter is arranged alphabetically; is presented in brief, clear statements and descriptions; and the whole is appropriately and well illustrated. Price, $2.60.

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POPULAR MISCELLANY.

Meeting of the American Association.—The forty-fourth meeting of the American Association for the Advancement of Science will be held in Springfield, Mass., August 28th to September 7th. Ample provisions have been made by the local committee for the accommodation of the association and its sections and for the entertainment of those who will attend. The meetings will be held in the Young Men's Christian Association building, where the offices will be and the general meetings will be held; the Art Museum, the high-school building, Christ Church Parish House, Unity Church Chapel, State Street Baptist Church lecture rooms, South Church Chapel, and Evangelist Hall. A large list of excursions has been arranged, to places in the vicinity of Springfield and some longer ones, adapted to almost every taste, a large proportion of them being to factories or laboratories where manufacturing processes and scientific methods are practically illustrated, and a considerable number to interesting geological fields. Meetings of affiliated societies will be held as follows: Geological Society of America, August 27th and 28th; Society for Promotion of Agricultural Science, August 26th; Association of Economic Entomologists, date not given; Association of State Weather Service, date not given; American Chemical Society, August 27th and 28th; American Forestry Association, September 3d; Botanical and Entomological Club of America, during the week. The president for the year is E. W. Morley, of Cleveland, O.; permanent secretary, F. W. Putnam, Cambridge, Mass.; general secretary, James Lewis Howe, Lexington, Va.; treasurer, R. S. Woodward, New York.

Lu Chu Islands Politics.—The history of the Lu Chu Islands for several centuries has consisted, according to Prof. Basil Hall Chamberlain, of "an attempt to sit on both sides of the fence." With China on the one hand and Japan on the other, "the kinglet of Lu Chu was driven into being a sort of Mr. Facing-both-ways; and the whole nation more or less, or at any rate the higher official class, came to have a double set of manners—one for use *vis-à-vis* the first of its inconveniently big neighbors, the other *vis-à-vis* the second. Thus the Japanese copper 'cash,' with which of late some of the commercial transactions of life had been carried on in the absence of any native money, were always carefully kept out of sight when the Chinese officials were by to see. On the other hand, the Chinese year names commonly current in Lu Chu were ignored as far as possible in diplomatic intercourse with Japan. Even in matters of food the poor little Lu Chuans tried to make themselves all things to all men." Of the two patrons China was the favorite, notwithstanding that Japan was more nearly allied by race. The Chinese overlordship was rather nominal than real, and the tribute-ships dispatched annually to Fu Chau did such good strokes of business under the rose that the Lu Chuans actually requested to be allowed to send more tribute to China than the amount originally stipulated.

Undisturbed Nature.—M. de Conferon relates in La Nature that a fox, which had established itself on his place, made nightly excursions for several months into his garden and yard. He was rather pleased with the visits than otherwise, being a lover of animals, and interested in the study of the habits of this one. The marks the fox left behind him indicated that, while he might be fond of grapes, he could eat a great number of rats and mice, and of beetles and oth-

er insects too. The many little excavations found everywhere pointed likewise to fondness for crickets and worms. It seems from his observations that foxes are not so mischievous as they are reported to be, and that while they may have their faults, these are to a large extent compensated for by services they render. Yet they are fond of fowls and hares and rabbits; but M. de Conferon remarks that there are not so many hares in the whole region around as in the neighborhood of his estate. Squirrels, jays, magpies, and the like, which are regarded as before everything else destructive, are allowed to build their nests and eat nuts at will on his premises, but he has never found that they prevented his having an abundance of little birds of all sorts, and his shrubbery is filled with the nests of singing birds that are scarce in other places. He ascribes his blessing to the fact that no guns are ever fired on his place. Birds are not destroyed there, or frightened or disturbed, and the children never take a nest. Nature is allowed to take its course without interference, and there is no trouble. That is the secret of the whole matter.

Electricity and Plant-growing.—Experiments in the application of electricity to plant-growing are recorded by Prof. L. H. Bailey in the Transactions of the Massachusetts Horticultural Society. Deherain had found that the electric light contained rays harmful to vegetation, and that the greater part of the injurious rays were modified by a transparent glass. Exposing different kinds of plants to the light, Prof. Bailey found that they were differently affected. He then tried the effect of the light screened with glass and also of the naked light running half the night. The influence of the naked light upon the productiveness and color of flowers was found to vary with the different species, and different colors within the same species. Tulips were of deeper and richer color, but the colors lost their intensity after four or five days. Petunias were much taller and more slender in the light. But all flowers, of whatever species, which stood within five or six feet of the naked arc were injured. It was apparent, in general, that the light hastened blooming and caused the production of larger stems; but this effect was much obscured by the injuries resulting from the unscreened arc. It was afterward found that the use of a globe or pane of glass will avert the injuries to flowers as well as to foliage, and the long stems and open inflorescence, together with the increase in earliness in some cases, may be obtained without fear of injury. But Prof. Bailey is not ready to recommend the electric arc lamp for the growing of flowers. Lettuce, however, was greatly benefited by the electric light, and filled its heads much earlier than under normal conditions. The injury done to the plants by exposure to the naked light was found to be due to the fact that their vital activity was so hastened by it that the plant could not supply material quickly enough, and it was forced to death; but by removing it to greater distances from the lamp a point will be found where water can be supplied with sufficient rapidity to meet the demands of the quickened activities, and the plant will grow more rapidly, or at least mature earlier, than in normal conditions. The application of electric currents to plant-growing may be made to the plant directly, to the soil, or to the atmosphere. Concerning the first condition, little of an exact nature can be said. A mild electrical discharge will often seriously injure plants; but application to germinating seeds and ripening fruits sometimes hastens the processes. The results in application to the soil are various, and it so far promises little in the way of commercial returns. The effect of atmospheric electricity has been studied by several observers, with the general results, from which only Naudin dissents, that normal atmospheric electricity is in some way beneficial to vegetation. Lemström has suggested that the modifications produced by it are not the direct results of the electrification of the plants or the atmosphere, but rather follow some change in the atmosphere which is engendered by the current—and this, Prof. Bailey thinks, is highly probable.

The Vision of Spiders.—Uncertainty seems to exist among arachnidists concerning the extent and quality of the spider's visionary power, and methodical experiments have been made by Mr. and Mrs. Peckham to determine the fact. Twenty species of *Attidæ* and others of other families were studied. The

authors find that "the power of expression through different attitudes and movements is of great assistance in determining not only how far the spider can see, but how much it recognizes of what it sees—or, in other words, its power of distinct vision—since it acts in one way when it catches sight of its prey, in another at the appearance of a male of its own species, and in still another when it sees a female. Dr. McCook says 'their rapid and marked change of manner when prey is sighted, the mode of approach, like the action of a cat creeping upon a bird, the peculiar behavior displayed when the final spring is made, are not to be accounted for on any theory other than a keen sense of sight.'" Among many incidents very much alike related by the authors we cite the case in which eight gnats and four small flies were put into a box containing one of the spiders. "They all settled and became quiet. The spider, neglecting several gnats and flies which were close to him, fixed his eyes upon a gnat five inches away, and, approaching it by short jerks from in front, pounced upon it, holding it tightly a moment and then letting it go. One of its legs was broken. It fluttered off to a distance of seven inches. After a moment the spider followed it and caught it again, still paying no attention to several nearer ones. This he repeated six times, letting it go each time. He then began to catch other gnats and flies at distances of from one to four inches. He made in all twenty-five captures, jumping always when about an inch away. His actions were exactly like those of a cat playing with a mouse. It seems remarkable that he could see clearly enough to follow the gnat which he had at first singled out among a number of others which were almost identical in appearance." Experiments on *Attidæ* at their mating season prove that spiders can see at a considerable distance. A male was put into a box containing a female of the same species. The female was standing motionless twelve inches away, and three inches and a half higher than the male. "He perceived her at once, lifting his head with an alert and excited expression, and went bounding toward her. This he would not have done if he had not recognized her as a spider of his own species. When four inches and a half from her he began the regular display of the species, which consists of a peculiar dance. This he would not have done had he not recognized her sex. A male of this species on the floor of the box caught sight of a motionless female on the glass nine inches away and four inches and a half above him. He raised his body almost vertically, and gazed alternately at her and at a male which was five inches away in another direction. At other times the males recognized the females at eight, nine, and eleven inches, and the females recognized the males at six, seven, nine and a half, and eleven inches." A spider can not recognize its egg sac by sight, because in its natural position it never sees it, and therefore does not know how it looks. Experiments on the color sense of spiders were not conclusive.

British New Guinea.—The colony now called British New Guinea has been formally annexed to the British Empire. The natives, who probably number between 300,000 and 400,000, are described by Sir William Mac gregor, administrator, as mostly of a rich, dark bronze color, varying from a brown that might be called black to a yellowish brown. In temper they are cheerful, lively, and full of fun, and are generally very contented; not quarrelsome or violently passionate. Suicide is comparatively rare among them; when it does take place, it is, as a rule, the outcome of affection, one of the strongest and best characteristics of the race. Occasionally a woman would climb a tall cocoanut tree and kill herself by jumping down, because she had become convinced that she could never meet again among men with a husband so good as the one she had lost. This family affection is so strong as to be often an impediment to the employment of men away from their own districts. It is not often that a man cares to remain longer than one year in the constabulary, because he is separated there from his family and friends. The London Missionary Society finds it difficult, for the same reason, to get wives of native teachers to live in strange villages. Yet the strong feeling of affection that the Papuan has for his relatives and neighbors does not prevent him from doing to others what appear terribly cruel things.

It must be recollected, however, that cruel murder is, according to their code of ethics, a conspicuous virtue, a moral duty. They all apparently believe that man is compounded of a body and spirit. The spirit leaves its tenement during sleep, and at death does not return. Hence, in waking up a sleeper, they proceed to rouse him by degrees, so that the spirit may have time to return and take its place.

Korean Marriages.—Korean girls, according to Mr. H. S. Saunderson, after enjoying freedom till they are eight years old, are consigned to the women's quarters, where they live in seclusion till they are married, at sixteen or seventeen years. After marriage the woman is allowed to see no man but her husband. The boys, on the other hand, are taught that it is undignified for them to enter the women's part of the house. They never see their brides till the wedding day, all having been arranged for them, often when both bride and groom are infants. The marriage ceremony is very simple. The bride and bridegroom invite their most intimate friends to assist them in dressing their hair in the manner befitting their new estate. Then the bridegroom mounts a white pony, which is led by two servants, while two others on either side support the rider in his saddle. Thus he proceeds to the bride's house, accompanied by his relatives. At their destination they find a pavilion erected in the courtyard of the house, in which the bride and her relatives are awaiting their arrival. A goose (the Korean symbol of fidelity), which the bridegroom brings with him, is then produced. The bride (who has to cover her face with her long sleeves) and the bridegroom then bow to each other until their heads almost touch the ground. This they do three or four times, and are then man and wife. A loving-cup is passed round, and then the bride is taken off to the woman's apartments of her husband's home, where she is looked after by her mother and mother-in-law, while the groom entertains his friends. Fidelity is imposed on the wife, but the husband is under no such obligation. He can marry but one wife, it is true, but he is allowed as many concubines as he can afford. These, however, never inhabit the same house as his principal wife. The husband is forced to maintain his wife properly and treat her with respect. Marriage is the great event in a Korean's life, for he then attains man's estate. Before marriage, no matter how old he may be, he is treated as a boy, and has to maintain a deferential attitude toward the married men, even though they be only half his age.

Rapid Transmission of Earthquake Motion.—Attention is called by Prof. John Milne to the apparently high velocity with which motion is transmitted from an earthquake center to places far distant from it—a quarter of the earth's circumference—and to the importance of instituting an extended systematic observation of these movements. During the last few years European observers have recorded earth movements that had their origin in Japan or in other distant countries. Beyond a radius of a few hundred miles from their origin these disturbances are often too feeble to be sensible or to be recorded by ordinary seismographs. Their presence is, however, made known by the use of specially contrived nearly horizontal pendulums, and it is found that they have a duration of from ten to thirty minutes, and sometimes last for one or two hours. Observations made at Tokyo of the earthquake of March 22, 1894, the distance from the epicentrum being about six hundred miles, indicated that the rate of propagation of the motion of the waves was from 2·3 kilometres per second for the more pronounced superficial waves, to 11·5 kilometres per second for the lighter shocks, and they passed to Italy at the rate of nine or ten kilometres per second. An investigation is especially wanted of the velocities of propagation of the elastic movements which apparently go from Japan to Europe in fifteen or twenty minutes. Prof. Milne has devised some delicate instruments expressly to be used in these investigations.

American Nickel Mines.—The nickel mine at Lancaster Gap, Pa., belongs to the class of ores described by Prof. J. H. L. Vogt, of Christiania, Norway, as typical deposits of nickeliferous sulphides, formed by a process of magnetic differentiation in basic igneous rocks. It is situated about three miles south of the main line of the Pennsylvania Railroad, a little more than fifty miles west of

Philadelphia, and fifteen miles north of the Maryland border. It lies in the midst of mica schists, presumably Archæan, in what was called the middle gneissic belt by H. D. Rogers, and the Georgetown series by Persifor Frazer. This formation is quite narrow in the vicinity of the mine, and pinches out to the westward, from the coming in of the limestone on the north and south sides. The dark, basic rock with which the ore is associated forms a lenticular mass of rock, which consists most largely of green secondary hornblende, and often shows almost nothing else than this mineral. It is called hornblende at the mine, and is best described by the word amphibolite as a rock name. The pyrrhotite lens on Anthony's Nose, near Peekskill, on the Hudson, is quite different in its geological relations from the Gap mine. It is situated on the northern side of the mountain, about seven hundred feet above tide water, and three miles from Highlands Station. The general geology consists of the usual gneisses of these old formations. Several well-known iron mines lie about twenty miles northeast. The ore bed was opened shortly after the war, when it was known as the Phillips Mine, and was operated for ten or fifteen years, but for sulphur fumes, and not for its metallic contents, which proved too low for profit. Other minor nickel-bearing beds have been noticed along the Hudson. Openings for nickel in gneiss have also been made at Litchfield, Conn.; at Dracut, near Lowell, Mass.; and perhaps at other points. The geological relations seem to be practically the same as those along the Hudson. These ores and the formations in which they occur have been fully described in a paper of the Geological Department of Columbia College, by J. F. Kemp, in the light of Prof. Vogt's views of the igneous origin of the ores.

The Former Antillean Continent.—The theory of a former kind of continental extension—the Antillean continent—which united the West Indies to the mainland, excluding the Atlantic waters and admitting the Pacific waters into the Mexican Gulf and the Caribbean Sea, has been examined in the light of the geographical and geological evidences by J. W. Spencer, who has attempted to restore the topography of the submerged continent and to set forth the geomorphic evidence that the drowned valleys of the Atlantic coasts are the valleys of former lands now depressed beneath the sea. These valleys or fiords are very numerous, and many of them are traceable to depths of more than two miles along the Atlantic, Gulf, and Caribbean coasts. The measurements of them give data for calculating the late elevation of the region. From the application of the continental movements it becomes apparent that the mainland stood as high as the fiords are deep, less some correction for unequal subsidence of the continental region. Accordingly, it is concluded that the Antillean bridge stood at from one and a half to two and a half miles above the present altitudes of the plains that now form the islands, with their mountains relatively somewhat lower than at present. The formations out of which the valleys are excavated belong mostly to the more recent geological periods, and are generally but little disturbed. From the determination of their age and that of the materials filling the buried valleys, it has been found that there were two epochs of great elevation, namely, in the Pleiocence and in the Pleistocene periods. Between these there was a subsidence of such depth as to drown the continental coastal plains, and reduce the West Indian region to very small islands, with (probably) a shallow connection between the Atlantic and Pacific coasts.

The Gothenburg System.—What is called the Gothenburg system of regulating the sale of intoxicating liquors is undergoing fierce criticism in England, where its adoption is favored by the Public-House Reform Association, founded by the Bishop of Chester. Under this system the traffic is made a concern of the community, and is carried on in its behalf by a company to which it is committed under conditions. The principles of the theory of popular control of the liquor traffic are summarized by the Rev. F. S. McC. Bennett, Honorary Secretary of the Public-House Reform Association, as being that licenses, though they have been granted for years to private persons and have been renewed with such regularity as to give them a marketable value, are essentially local public property, and the community, while bound to recognize the equitable claims of those whom it

has allowed to hold them, is entitled to deal with its own in whatever way seems best calculated to promote the public weal; that those communities which, though unprepared to veto the liquor traffic, desire to reduce the consumption of alcohol, should be granted the option of local management. The "company" feature of the Gothenburg system is sharply attacked by W. S. Caine, M. P., who, while admitting that there has been a sweeping reduction in the intemperance of Scandinavia, in consequence of the Swedish law of 1855, asserts that this is not in consequence but in spite of the company system, "the ingrafting of which upon the law of 1855 has been followed by an increase of drunkenness in every large city in which it has been adopted. Undoubtedly," Mr. Caine continues, "the drunkenness of Norway and Sweden is very greatly reduced from that prevailing thirty years ago; but it is due entirely to other causes than the company system, was realized before the company system came into operation at all, and has reverted to a steady increase since the company system prevailed." The most important evidence adduced in favor of this proposition is derived from the statistics of convictions for drunkenness, which appear to have increased since the company system went into operation. Mr. Bennett replies that the small increase remarked in the number of convictions indicates increased vigilance, activity, and efficiency in enforcing the law quite as much as increased violation of it, and he quotes strong counter-evidence against other allegations that drunkenness has increased.

Flowers and their Unwelcome Visitors.—Having, in a lecture on the pollenization of flowers, considered the means by which the plants secure the aid of insects in that work, Prof. L. H. Pammel mentions a few of the methods by which flowers are protected from the invasions of unwelcome insects. Aquatic plants are protected by their isolation in water. Land plants have occasionally secured the same advantages for themselves by certain leaves forming cups around the stem; some have a leaf-cup at each joint; in others there is a single basin formed of the rosette of leaves at the base, in which rain and dew collect, and are retained for a considerable time. Some plants have slippery leaves, with often a curved surface, over which it is impossible for ants to climb; others are covered with hairs and spines, especially in the parts near the corolla, which often point downward. Some plants are distinguished by viscid and gelatinous secretions. Kerner believes that the milky juices of such plants as lettuce, asclepias, euphorbia, apocynum, chelidonium, etc., serve to keep ants away. Relative to hybridization, Prof. Pammel finds that hybrids between widely separated species are usually tender, especially in their early life, so that it is hard to grow such seedlings. Hybrids of species of closer relationship on crosses of races are usually strong and productive. Such plants are characterized by their greater size, rapid growth, early maturation of the flowers, longer life, greater productiveness, and unusual size of the separate organs.

Abrasive Substances.—The growing importance of abrasives is such as to suggest inquiry concerning our future supply, and that is one of the topics considered by T. Dunkin-Paret in his paper on Emery and other Abrasives. At present we depend for the larger part on Turkey and Greece. Emery occurs also in Sweden, Spain, Saxony, and Greenland, but the lands named are apparently the only foreign countries that afford a commercial supply. Our supply of native emery has come thus far from New York and Massachusetts, while the corundum has come from Pennsylvania, North Carolina, and Georgia. While small specimens of corundum, in the form of imperfect sapphires, have come from Montana, where the existence of this mineral has long been known, no other locality has yielded corundum except the belt which reaches from Massachusetts to Georgia, and seems to have its center in the corner where North and South Carolina, Georgia, and Tennessee come together. In this belt the localities where the mineral occurs are innumerable, but its prevalence is a poor indication of its quality. Corundum occurs in pockets, seams, sand veins, narrow streaks, and detached crystals, seldom in large mass. Chester County, Pennsylvania, is apparently the only locality where large, solid masses have been found. The largest annual prod-

uct of American corundum was six hundred and forty-five tons. Unlike corundum, emery consolidates in large masses. It does not, indeed, form continuous beds of great extent, but its discontinuous masses and veins sometimes contain hundreds of tons. The emery-bearing locality in Westchester County, New York, is a strip from one half to three fourths of a mile in width and from five to six miles in length. The place in which the largest openings have been made, and which has excited the most interest, is on a part of a summit about three miles from Peekskill and seven hundred or eight hundred feet above tide level. It overlooks, on the one side, the valley of the Croton, whose stream is invisible, and, on the other side, the Hudson. On the north and northeast of the emery belt are outcrops of granite. South of it lies the common marble of Sing Sing; still farther south, at Spuyten Duyvil, occur the oldest of the Laurentian gneisses; and still farther south, on Manhattan Island, the mica schist. The emery is, however, all immediately associated with a hornblende rock. Large masses of emery are seen projecting above the surface. These are delusive, and those which hold out a large promise are sometimes found to extend only one or two feet underground and to yield only from five to twenty tons. Such masses are usually surrounded by soft, reddish earth.

Substitutes for White Lead.—Only two substances at present manufactured are regarded by Mr. A. P. Laurie as satisfactory substitutes for white lead in painting—sulphate of lead and oxide of zinc. Sulphate of barium has hardly any covering power, and sulphide of zinc, though remarkable for covering power, has not proved, as at present manufactured, a durable pigment. Oxide of zinc, though deficient in covering power, is remarkably white, and preserves its color in impure air. Sulphate of lead is in the market in two forms—sublimed sulphate, which is prepared directly from galena; and precipitated sulphate, ground by Freeman's patent with oxide of zinc, and sold as Freeman's white. Sulphate of lead prepared by sublimation has much more covering power and is much denser than precipitated sulphate. Another pigment sold as a harmless white lead is prepared in a similar way by grinding together oxide of zinc and sulphate of barium. In quantity of oil required the substitutes named compare well with white lead, some taking a little more and some a little less, except oxide of zinc, which takes a very large quantity. In the matter of susceptibility to impure air, they all have a distinct advantage over white lead. Zinc oxide is not at all affected, and the sulphate is very slightly affected unless the gas is in very large quantities and the paint is wet. In durability under outdoor exposure they are not better than white lead, except that oxide of zinc remains white. In their appearance in oil they differ considerably from white lead, being thin and stringy instead of stiff and firm, and this is against them. But Mr. Laurie does not find that when thinned down they seem to differ appreciably from lead carbonate in ease of working. In their effects on health, oxide of zinc is harmless. Sulphate of lead is not absolutely insoluble in very weak hydrochloric acid, and may therefore be slightly soluble in the stomach and to some extent poisonous; but the author does not believe that under ordinary conditions of manufacture or use it would produce lead poisoning.

The Dangerous Proportion of Carbonic Acid.—Of the power of carbonic acid to smother, Prof. F. Clowes, of Nottingham, England, ascertained that the flames of candles, oil, paraffin, and alcohol are extinguished by air containing from thirteen to sixteen per cent of carbonic acid. The flame of coal gas requires the presence of at least thirty-three per cent of the extinguishing gas, while the flame of hydrogen requires fifty-eight per cent. Concerning the proportion of carbonic acid mixed with water that can be breathed with impunity, the statements of different observers are conflicting. Prof. Clowes finds ten per cent more than is required to extinguish a candle flame respirable, while Dr. Haldane, of Oxford, estimates that air containing twenty per cent of carbonic acid can not be breathed, even for a minute, without serious consequences; even five per cent, he claims, caused serious distress of body and mind, while any proportion higher than ten per cent produced distinct poisonous effects.

The vitality of the hydrogen flame in foul air, Prof. Clowes points out, makes it useful for maintaining the flame of a miner's safety lamp in an impure atmosphere. The author's testing lamp, which burns either oil or hydrogen, or both together, can be carried into foul air with both substances burning. The oil flame is extinguished as soon as the proportion of carbonic acid reaches a certain limit, while the hydrogen continues to burn. As soon as the miner goes back into a somewhat purer atmosphere, the still burning hydrogen relights the oil flame, and the miner is not left in complete darkness, as he otherwise would be.

The Earth's School of Enterprise.—In his study of the Relation of the Earth to the Industries of Mankind, Prof. O. T. Mason infers that the earth was in the beginning and is now the teacher of the activities through which commodities are conducted through the progress of industries. "There were quarriers, miners, lumberers, gleaners, and some say planters; there were fishermen, fowlers, trappers, and hunters before there was a *genus homo*. There were also manufacturers in clay, in textiles, and in animal substances before there were potters, weavers, and furriers; there were all sorts of moving material and carrying passengers and engineering of the simplest sort. It might be presumption to hint that there existed a sort of barter, but the exchange of care and food for the honeyed secretions of the body going on between the ants and the *Aphidæ* looks very much like it. The world is so full of technological processes brought about among her lower kingdoms that I should weary you in enumerating them. Stone-breaking, flaking, clipping, boring, and abrading have been going on always, by sand-blast, by water, by fire, by frost, by gravitation. Archæologists tell us that savages are very shrewd in selecting bowlders and other pieces of stone that have been blocked out and nearly finished by Nature for their axes, hammers, and other tools. In tropical regions of both hemispheres where scanty clothing is needed, certain species of trees weave their inner bark into an excellent cloth, the climax of which is the celebrated tapa of Polynesia. Furthermore, the fruits of vines and trees offer their hard outer shells for vessels and for other domestic purposes, and as motives in art and handicraft. Among the animals there is hardly one that has not obtruded itself into the imaginations of men and stimulated the inventive faculty. The bears were the first cave dwellers; the beavers are old-time lumberers; the foxes excavated earth before there were men; the squirrels hid away food for the future, and so did many birds; and these were also excellent architects and nest-builders; the hawks taught men to catch fish; the spiders and caterpillars to spin; the hornet to make paper, and the crayfish to work in clay."

A Generation of French Science.—The Revue Scientifique, of Paris, last November entered upon its thirty-third year. Noticing the event, it recalled the fact that when it was begun, in 1863, the Darwinian theory was only timidly sustained by a few, while it was contested by most men of science—in France at least. The Revue fought actively for it from the first, and for ten years gave it the most prominent place among subjects discussed. After that it gave other questions, including the new ones as they sprang up, a larger share of attention. The purpose which the Revue has constantly pursued has been to keep scientific readers acquainted with the work accomplished by other students in related or neighboring fields, and thereby serve as a kind of bond of connection between the scattered members of the scientific body. The collected volumes, according to the Revue's own expression, constitute a kind of gigantic scientific encyclopædia, in which may be found the traces of great scientific contests mingled with dogmatic expositions of the most glorious contemporary discoveries.

Sewer-fed Oysters.—Concerning the possible contamination of oysters by sewage, which seems to be demonstrated by experiences at Middletown, Conn., Nature says: "It has been alleged, on the evidence of certain recent bacteriological investigations as regards the contents of London sewers, that the organism producing typhoid fever can not live and multiply in sewers. But the organism has been found in sewers; it also lives in sea-water; and the fact remains that sewage bathes our oysters during cultivation

to an extent that is essentially disagreeable and that ought not to take place; and also that typhoid fever follows the use of oysters so cultivated. It may also be alleged, as is done by certain oyster-growers, that sewage is fatal to the oyster itself. In answer to this we can only say that such evidence as we have obtained as to some of our oyster beds is absolutely opposed to this statement; and not only so, but we know of more than one instance where the oysters are deliberately brought from the beds to fatten in still nearer proximity to outfall sewers for a week or more preliminary to their sale. In brief, if sewage and noxious micro-organisms can be retained in the beard and other portions of the oyster, or in the 'juice,' which is so much relished, everything seems contrived to secure such retention of filth at some of our oyster fisheries."

Japanese Bronze Casting.—The casting of bronze has been carried on in Japan from very early times, reaching nearly, if not quite, back to the settlement of the country by its present inhabitants, seven or eight centuries before Christ. It appears to have been developed since then with the course of the centuries, each successive period having its peculiar styles and being distinguished by its more remarkable works. Among the great works of the bronze founders of the early seventeenth century were a colossal figure of the Buddhist divinity Rochana in Kioto, built to replace the wooden image that was destroyed by an earthquake in the previous century, and a huge bell for the temple. The image was nearly sixty feet high, and was cast where it stood, in segments, the mold being built upon the parts already finished. It was completed in 1614, but was destroyed forty-eight years afterward by an earthquake. The bell is the largest in Japan, and is about fourteen feet high, nine feet in external diameter at the mouth, and ten and three quarters inches thick at the rim, which is swelled internally so as to constrict the mouth. It is this constriction that causes the gentle rising and falling tones that characterize the boom of all Japanese bells. Two other similar bells were cast during the first half of the seventeenth century. Mr. W. Gowland, late of the Japanese Imperial Mint, says that the casting of a large bell in old times in Japan was an important event, and was accompanied by religious ceremonies and popular rejoicings. On the day appointed for running the metal into the mold a grand festival was held, which people of all ranks came from far and near to attend, with contributions, many with offerings of mirrors, hairpins, and metal ornaments, to be added to the bronze. On one occasion the Shogun himself was present and took part in the direction of operations.

Revival of Ramie Cultivation.—The cultivation and treatment of the ramie plant as an industrial product are again attracting attention as a field for the profitable employment of capital. It was apprehended at one time that the returns from cultivation had so far fallen short of expectation as to discourage further effort with it. The plant has, however, been closely studied in all its phases for three or four years past, and the processes of decorticating and degumming the stalks have been established upon a scientific basis. As the ramie gives an exceedingly small quantity of raw fiber—about three and a half to three per cent of the weight of the green stalks—the only way of making it a commercial success has been to treat it in enormous quantities at the lowest possible limit of cost. This necessitated the designing of machines upon the simplest lines. Many of the machines have recently been greatly improved, and their mechanism has been simplified to the apparent limit. Hence the ramie problem seems to have been definitely solved.

Overhead Wires and Lightning.—Concerning the influence of overhead electric wires in reference to safety from lightning, it is to be remembered, the Lancet says, that an overhead telephone wire becomes in point of fact a lightning conductor, and in this capacity may act in two ways: by equalizing differences of potential it may prevent the occurrence of the disruptive discharge; or, by receiving a lightning charge, it may carry the current to the earth. There can be little doubt that overhead conductors if connected with the earth play an important part in the distribution of atmospheric electricity. Lord Kelvin, in a recent paper, said that the

difference of potential he obtained between the earth and an insulated burning match placed nine feet above the ground was from two hundred to four thousand volts. What, then, is the result of permanently connecting by a good conductor the earth and the atmosphere directly above it, a condition that exists in the case of single-wire circuits? Such an arrangement must tend to equalize potential and prevent the accumulation of those charged masses which no doubt form the nucleus of the storm cloud. This equalization will continue to take place in all conditions of weather. But when a storm occurs it is obvious that if struck by lightning the wire carries the current to the point of greatest range—viz., to the instrument and to any one in its vicinity. Therefore, unless the strictest structural precautions be taken, such a wire becomes a source of danger rather than of safety. To obviate this danger, every post or support for overhead wires ought to be fitted with a lightning guard, and every instrument, whether using the earth as a return or not, should be furnished with a lightning arrester.

Conditions of Sleep.—Some interesting experiments on sleep have been made by Prof. I. Tarchanoff, of St. Petersburg, upon puppies from three weeks to three months old. The animals at this age have a strong disposition to sleep, and are not awakened even when physiological experiments are made upon them—a few minutes' stroking of the head and back assuring the persistence of their slumbers or their return to sleep if they are aroused. Adult dogs will not sleep under such circumstances, except with the aid of a narcotic. Position of the body exerts a distinct influence on the sleeping. Puppies lightly strapped were placed, some in a horizontal and others in a vertical position, and of the latter some were held with the head downward and others with the tail down. Stroking and caressing failed to induce sleep only when the head was kept down. Other experiments demonstrated that the arterial pressure falls during sleep, and that when the animal wakes it returns to its former height. These facts agree with the statements and observations of Mr. Darben that the brain is anæmic during sleep. Further experiments were made by Prof. Tarchanoff on animals in which the spinal cord had been divided between the dorsal and lumbar regions, and the animals had recovered from the immediate effects of the injury. The result was expressed in the observation that the spinal cord never sleeps. The author thinks, further, that the brain is not during sleep inactive in all its parts, but is a source of depressed action propagating itself to all parts of the cord which are in perfect continuity with the brain.

Physiological Influence of Music.—In the investigation of the influence of music on man and animals, Prof. Tarchanoff, of St. Petersburg, used the ergograph of Mosso, and found that, if the fingers were completely fatigued, music had the power of making the fatigue disappear. It appeared that music of a sad and lugubrious character had the opposite effect, and could check or inhibit the contractions. The author is inclined to suppose that the voluntary muscles, being furnished with excito-motor and depressant fibers, act in reference to the music similarly to the heart—that is, that joyful music resounds along the excito-motor fibers and sad music along the depressant or inhibitory fibers. Experiments on dogs showed that music was capable of increasing the elimination of carbonic acid by 16·7 per cent, and of increasing the consumption of oxygen by 20·1 per cent. It was also found that music increases the functional activity of the skin. The author claims as the result of his experiments that music may fairly be regarded as a serious therapeutic agent, and that it exercises a genuine and considerable influence over the functions of the body.

NOTES.

A TIMELY protest is made in the Pharmaceutische Rundschau against the proposition of some pharmaceutical schools to confer the degree of Doctor of Pharmacy. A forcible objection to the use of the term doctor in this connection was uttered in 1874 by the Board of the Philadelphia College of Pharmacy, which deprecated the use of that title because the practices of pharmacy and medicine were so closely connected with each other that it would tend to confusion. A dispensing druggist possessing it would be supposed to have the right to prescribe, and danger of conflict

would arise. President Gilman, of Johns Hopkins University, writes to the editor of the Rundschau that by expediency, usage, and justice, "the ancient and honorable title of a doctor should not be bestowed or accepted in any unjustified way," and that the proposed application of it is likely to mislead the public. Other confusion may arise, too, from the use of the initials Ph. D., which are those of Doctor of Philosophy, a degree that implies the successful pursuit of some special study. The title of Master of Pharmacy, already in use, is appropriate and significant, and should be held sufficient.

A CURIOUS theory of the channels on Mars is propounded by Mr. Törnebohm, of Stockholm, which is worth citing for its ingenuity. With a drier atmosphere and less mountainous relief than the earth, Mars must have large desert tracts. Across these its enterprising inhabitants have constructed trade roads, which they have furnished with artesian wells and possibly with canals, for the convenience and facilitation of traffic. This irrigation has promoted the growth of vegetation for a considerable distance back of the roads on either side, and the dark marks it makes are what we call the channels.

OBJECTIONS to the use of wood in warships arise out of its combustibility and its liability to splinter. A board of experts commissioned by the United States Navy Department to consider the subject of dispensing with it and of finding a substitute for it, has decided that the substitute sought should be light, or not heavier than wood, nonconducting, noncombustible, and, when struck by shot, should not fly into splinters. It suggests, as a direction in which the search for a substitute should be made, to select something in the nature of cheap wood or vegetable fiber and fine sawdust; treat them chemically with some insoluble fireproof substance, not too heavy; then press and roll into boards, more or less dense, according to the use for which the material is desired.

AN international and representative committee of one hundred and eighty men of science has been formed for the erection of a monument to the late Prof. von Helmholtz. The Emperor of Germany has promised ten thousand marks and a free site for the purpose.

THOREAU records in his journal how he witnessed the formation of a ravine in the course of a February thaw. "Much melted snow and rain being collected on the top of the hill, some apparently found its way through the ground frozen a foot thick, a few feet from the edge of the bank, and began, with a small rill, washing down the slope the unfrozen sand beneath. As the water continued to flow, the sand on each side continued to fall into it and be carried off, leaving the frozen crust above quite firm, making a bridge five or six feet wide over this cavern. Now, since the thaw, this bridge, I see, has melted and fallen in, leaving a ravine some ten feet wide and much longer, which now may go on increasing from year to year without limit. I was there just after it began."

A NUMBER of explosions of gas have recently occurred in London, which are supposed to have been connected with the electric-lighting conduits, though the connection was not in every case traced, so that Major Cardew, who has investigated them, has sought for other possible causes. As shown by his report, the most striking features about the accident of four explosions on Southwark Bridge were the distance to which a series of explosions may travel along the electric mains; the proof the event affords of the insufficiency of any ordinary ventilation of the pipes and street boxes, if gas can find an easy access to them; and the necessity for exercising great care to make and keep the street boxes impervious to gas.

A SECTION of Anthropology was organized in connection with the Academy of Natural Sciences of Philadelphia on the 3d of April last, under the chairmanship of Harrison Allen, M. D. The purpose of the section is the presentation of original papers, the statement of interesting facts, the exhibition of illustrative objects, and the discussion of the methods included under the term anthropology. The meetings of the section will be held at the academy on the evenings of the second Friday in each month, from September to May. Communications should be addressed to Charles Morris, Academy of Natural Sciences, or 2223 Spring Garden Street.

THE fourth summer session of the School of Applied Ethics, at Plymouth, Mass., will continue from July 7th to August 9th. The school will embrace four departments: Economics, Prof. H. C. Adams, director; Ethics, Dr. Felix Adler, director; Education, S. T. Dutton, of Brooklyn, R. G. Huling, Cambridge, Mass., and Paul H. Hanus, of Harvard University, committee in charge; and History of Religions, Prof. C. H. Toy, director. A large variety of subjects will be discussed in these departments, with teachers and specialists of high repute leading; and in most of their relations to social questions those relating to labor will be held prominent.

PRIZES have been awarded by the adjudicators on behalf of the Leprosy Fund in England for five papers on leprosy—relating to the decline and extinction of the disease as endemic in the British Islands; its prevalence and decline in Iceland; its increase at the Cape and prevalence in South Africa; its extent and probable causes in Australia; and the conditions under which it prevails in China, Cochin China, Batavia, and the

Malay Peninsula. On some of the subjects for which prizes were offered no essays were sent in, and some of the essays sent in were held not to meet the terms of the competition.

A COMMITTEE of the British House of Commons appointed to consider the advisability of adopting the metrical system of weights and measures has found many considerations in favor of the movement. An engineering firm has used the system for several years, having adopted it on account of the advantage of working interchangeably with engineers on the Continent. Their workmen were agreed that the entire system was easier to deal with than the English measures, and was much less liable to error. Dr. Gladstone insisted upon the superior facility of teaching the metric system. As the children have to learn decimals, very little more time would be needed by them for learning the metric system.

OBITUARY NOTES.

PROF. JULIUS LOTHAR MEYER, one of the greatest of chemists, died "suddenly, gently, and painlessly," at Tübingen, Germany, April 12th, in the sixty-fifth year of his age. He was born in 1830; studied at Zurich, Würzburg, Heidelberg, and Königsberg, medicine, chemistry, and mathematical physics; was graduated doctor of medicine from Würzburg in 1854; received leave to teach chemistry and physics in 1859; and was successively engaged in the Physiological Institute at Breslau, the Royal Prussian Forstakademie at Eberswalde, the Polytechnikum at Carlsruhe, and the University of Tübingen, where he was professor of chemistry for nearly twenty years, and where he died. His reputation as a philosophical chemist was based upon a work on Modern Theories in Chemistry, which he published in 1864, and which has appeared in a fifth edition and in an English translation. He was preparing a sixth edition at the time of his death. In 1883 he with Prof. Seubert recalculated the atomic weights of the elements from the original data, and published a book embodying their results. He was one of the earliest investigators of the relations between the properties and the atomic weights of the elements, and published a memoir on that subject in 1869, in which he arranged the elements in the order of atomic weights, in a single table, and indicated the periodic character of the dependence of properties on atomic weights. On this subject a question of priority arose between him and Mendeleeff. The case appears to be one of those of which the history of science offers many illustrations, in which two investigators reached similar results about the same time independently. In experimental chemistry, Lothar Meyer published memoirs in almost every branch, including those on the atomic weight of beryllium, on determinations of vapor densities, on the combustion of carbon monoxide, on the preparation of hydriodic acid, on the transpiration of gases, and on various organic compounds, etc.

PROF. KARL LUDWIG, the eminent German physiologist, died in Leipsic, April 25th. He was born at Welzenhausen, in 1816, and took the degree of doctor in 1839. He became a *privat docent* at Marburg in 1842; extraordinary professor at Zurich in 1849; ordinary professor in the Academy for Army Surgeons at Vienna; and for the last thirty years was professor of physiology at the University of Leipsic. His first published work was on the Mechanism of the Secretion of Urine. He improved physiological methods by the introduction of apparatus for the graphic recording of results; was the author of important researches on the circulation of the blood, on the influence of respiration on the circulation, and on the action of the medulla oblongata on the circulation; and he made very valuable researches on the part played by the nervous system in glandular secretion.

PROF. CARL VOGT, an eminent naturalist and original investigator on his own lines, from whom the Monthly has published several charming as well as instructive articles, died in Geneva, Switzerland, May 5th. He was born at Giessen, in 1817, and was particularly industrious in the study of freshwater mollusks. In 1845 he published, with Prof. Agassiz, a memoir on the anatomy of fishes of the family *Salmonidæ*, in preparation for which he had specially studied the different phases of the development of these fishes. This was the beginning of the investigation of the embryology of fishes. He gained much fame by the researches which he carried on, under the direction of Agassiz, on the formation and movement of glaciers, establishing a station, which was named the Hotel of the Neufchatelais, on the lower glacier of the Aar. In his later years he published, in conjunction with M. Jung, a treatise on zoölogy.

DANIEL KIRKWOOD, late Professor of Mathematics in Indiana State University, and a distinguished astronomer, died in Riverside, Cal., June 11th. He was born in Bladensburg, Md., in 1814; studied in the academy at York, Pa., where he became first assistant and mathematical instructor; was appointed Principal of the High School at Lancaster, Pa., in 1843; Professor of Mathematics in Delaware College in 1851, and president of the institution three years later; and served thirty years, from 1856 till 1886, as Professor of Mathematics in Indiana University. He was a frequent contributor on astronomical subjects to scientific journals, and published a book upon the asteroids, or minor planets between Mars and Jupiter.